Priority Sites for Conservation in Kiribati:

Key Biodiversity Areas

Preface and Acknowledgements

This booklet was written for the government of Kiribati and the general public to raise awareness about the key areas for conservation in Kiribati and the species most threatened with extinction. The work was developed as a partnership between the Secretariat of the Pacific Regional Environment Programme (SPREP); the Conservation International Pacific Islands Program (CI Pacific), and the Environment Conservation Division (ECD) of the Kiribati Ministry of Environment, Lands, Agriculture Development (MELAD). Birdlife International kindly provided their data on the Important Bird Areas (IBAs) of Kiribati. Natan Itonga, culture officer, provided key natural resource and cultural resource information throughout the three archipelagos of Kiribati. We acknowledge and thank MELAD and Nenenteiti Teariki-Ruatu of ECD, who secured funds for this project from the Global Environment Facility (GEF) through the Protected Areas Programme of Work (POWPA). We are very grateful for the technical support of ECD, Fisheries, Lands and Agriculture staff who provided invaluable guidance on the fieldwork and development context of the Kiribati POWPA program and to Trevor Durbin who provide invaluable technical and field assistance. We also acknowledge data obtained from the Millennium Coral Reef Mapping Project, Institute for Marine Remote Sensing, University of South Florida (IMaRS/USF) and Institut de Recherche pour le Développement (IRD/UR 128, Centre de Nouméa).

The report was written and edited by Schannel van Dijken of CI Pacific Islands Program with Paul Anderson of SPREP and assistance from additional reviewers including, Chase Childs, Lela Stanley, Sue Taei and Roger James. Additional staff from within CI, SPREP and the Government of Kiribati also provided comments and edits. Acknowledgement is also given to the many people who contributed to the development of this work, including Ratita Bebe, Tekimau Otiawa, Kiritian Batoromaio, Turang Teuea Favae and Arawaia Moiwa of ECD, Routan Tongaiaba from Agriculture and Lands division, and Toaea Beiateuea and Tuake Teema from the Fisheries department. Several individuals and organisations kindly allowed us to use their photographs and their credits are listed within the document and on the back page. Thank you is given to Kimberly Meek and James Sanday for their work on the layout of this product.

We are very grateful for the support and assistance provided by all. ko rab'a.

Suggested citation:

van Dijken, S. G., and Anderson, P. 2013. Priority Sites for Conservation in Kiribati: Key Biodiversity Areas. Conservation International Pacific Islands Programme, Secretariat of the Pacific Regional Environment Programme, Government of Kiribati Ministry of Environment, Lands, Agriculture Development. Apia, Samoa. 56pp.

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Minister's Foreword

On behalf of the President and people of Kiribati, I extend to you all warm greetings from Kiribati,

Kam Na Bane Ni Mauri!

As Minister for Ministry of Environment, Lands and Agriculture Development (MELAD), I have the honour to present to you this Key Biodiversity Area (KBA) Analysis report for Kiribati. The report is an important milestone achievement by MELAD in that for the first time, Kiribati is able to take stock of the status of its national biodiversity that exist within its islands and ocean waters. This report is significant. It will form the basis of the Government of Kiribati's direction towards designating areas and species that have significant biodiversity values at the national and global levels, including their important roles in supporting local livelihoods, human health, and economic growth in Kiribati.

Biodiversity and the natural environment is of paramount importance to the people of Kiribati because it supports our livelihoods, human health, culture, and way of life - as well as the ecological services provided by intact systems of reefs, fisheries, mangroves. Kiribati already holds the world's largest marine World Heritage site through the Phoenix Islands Protected Area (PIPA) and is a world leader in large-scale marine environmental policy and management.

Like many other small island developing states and least developed countries, Kiribati is not immune to multidisciplinary problems, - like waste, pollution, and unsustainable harvesting of biodiversity-based resources, to name a few. Additionally, there is increased incidence that the issue of climate change puts additional stress on our islands and the ecosystems that support the people of Kiribati. These are some of the threats that will continue to adversely affect the health and integrity of the biodiversity of Kiribati as an atoll nation in the Pacific region.

Wise and effective management and conservation of resources is one way to alleviate some of the pressures that have been found to adversely affect the biodiversity of Kiribati. By conserving our environment, we enhance Kiribati's chance of a bright healthy future with an abundance of the fish, birds and plant life we depend on. Biodiversity conservation and management supports sustainable development. It also provides economically feasible options for the people and Government of Kiribati to build the resilience and retain the liveability of our atoll islands.

This document is a step in the process of expanding the visionary thinking behind the PIPA to the rest of Kiribati's people and Islands.

Finally, please allow me also to express the sincere gratitude and appreciation of the Government and people of Kiribati to the Global Environment Facility (GEF) and the United Nations Development Programme (UNDP) as the implementing agency, for enabling Kiribati to participate in this global Programme on protected areas. Without this financial support, Kiribati would not be able to produce this KBA Report. Furthermore, I wish to acknowledge and commend the excellent support and technical assistance that have been rendered to Kiribati on this important assignment by the Secretariat of the Pacific Regional Environment Programme (SPREP) and Conservation International (CI). SPREP and CI's Pacific Island Program have played an instrumental role in the development of this report and the associated research. In the same calibre, MELAD also acknowledges the contributions and efforts of the stakeholders and members of the National Biodiversity Planning Committee, who have been engaged actively in the KBA report formulation as well as the fieldwork undertaken in the outer islands. Last but not least, I have much pleasure to sincerely thank the Island Councils and the people of the various islands that were visited in the course of this project for their hospitality and knowledge they have shared to MELAD. These have helped structure the contents and outcome of this KBA analysis.

Kam bati n rabwa.

Honourable Tiarite Kwong
Minister - Ministry of Environment,
Lands and Agricultural Development

Executive summary

In 2010, under Kiribati's Programme of Work for Protected Areas (PoWPA), a national ecological gap analysis (GA) was conducted. Its main purpose was to assess how effective the current Protected Areas (PA) network was at achieving Kiribati's National Biodiversity Strategies Action Plan (NBSAP) conservation targets, and in particular to identify priority areas for the expansion of the PA network and priority actions for improved management of existing PAs. A complementary objective was to identify the key gaps in our knowledge of the country's biodiversity.

The Secretariat of the Pacific Regional Environment Programme (SPREP) and Conservation International's Pacific Islands Program (CI-PIP) provided technical support to the Kiribati Ministry of Environment, Lands and Agricultural Development (MELAD) to conduct a GA of Key Biodiversity Areas (KBA – areas of high biodiversity and conservation value) in Kiribati, and provided advisory support for its PA network design. The KBA approach was applied at the archipelago (Gilbert, Line and Phoenix Islands) level combining terrestrial, coastal and lagoon habitats.

The KBA methodology applied here is based on an international standard methodology that focuses on worldwide threatened species. KBA sites – all designated at the island level - were identified based on the presence of globally threatened species. The KBA sites (Islands) were then prioritized based on three additional criteria including the frequency of species of local concern as identified by the NBSAP, Kiribati Adaptation Plan (KAP) II mangroves, and the PoWPA phase one consultations; areas of expert concern; and a habitat metric based on habitat diversity and numerical analysis of habitat types.

This KBA report outlines key recommendations for the Government of Kiribati and its people for protecting its unique biodiversity and supporting sustainable livelihoods. A total of twenty-two island KBAs were identified and suggested for immediate management. Outlined below are the identified KBAs in order of their recommended priority rankings for each island group:

GILBERT ISLANDS GROUP	PHOENIX ISLANDS GROUP	LINE ISLANDS GROUP
Abaiang	Rawaki (Phoenix Island)	Kiritimati (Christmas Island)
Abemama	Orona Atoll (Hull Island)	Tabuaeran (Fanning Island)
Nonouti	Abariranga (Kanton) Island	Caroline (Millennium Island)
Tabiteuea	Nikumaroro (Gardner Island)	Teraina (Washington Island)
Tarawa	Enderbury Island	Malden
Makin	Manra	Flint
Kuria	McKean Island	Vostok
	Birnie	

Eight of the KBAs are currently managed as PA's within the Phoenix Island Protected Area (PIPA) along with Kiritimati, which has mixed areas of current protection throughout the island. Malden and Vostok in the Line Islands also have wildlife status protection. The remaining islands have no ongoing active management. Prioritization and specific management recommendations for identified sites are provided in this report.

A key finding of this analysis was that there are significant taxonomic, thematic and geographic spatial information gaps relating to biodiversity knowledge in Kiribati, especially for the Line and Gilbert Islands. In contrast, the Phoenix Islands have been the subject of targeted biological research through the establishment of PIPA. Further targeted surveys are suggested for areas where the most notable identified gaps exist.

Another key finding of this analysis was that top priority sites where conservation and resource management efforts should be focused can be clearly identified and justified. Despite the information gaps relating to biodiversity knowledge in Kiribati, the next phase of protected area development is clear. Targeted action, working with engaged community and Island Council members to address their specific resource concerns as well as the national government's endangered species and habitat conservation priorities, is the way forward. It is the strong recommendation of the authors to prioritize initial PA implementation on the KBA islands with strongest support from the local island government for co-management. Co-management will create the appropriate setting for MELAD to backstop and support, by providing necessary expertise and guidance on good management practices, to an island government that is committed to addressing issues of resource management and conservation with their own local resources and time.

The finding of Kiribati's KBA analysis provides a sound link to several significant ongoing and new initiatives within the environment division and at the national level. This report identifies sites for PA management and PA network expansion. It also clearly highlights threatened species present in Kiribati and their locations as well as linking to the implementation of the NBSAP objectives. Both the Kiribati Integrated Environment Plan (KIEP) and the KAP II mangrove initiative implementation are supported by the KBA findings. Furthermore, the 2013 turtle nest monitoring and Ecosystem based Adaptation to Climate Change (EbACC) projects will be directly linked to the implementation of the findings of this document. Finally, the PoWPA phase two program will provide backstopping for the initial PA implementation.

Introduction

Biological diversity, or biodiversity, is the range of life on earth from genes to species to the entire biosphere. Biodiversity is defined as the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems. Biodiversity provides immeasurable current and potential benefits to human societies through medicine, food, materials, ecosystem services, and cultural values. Yet, this diversity of life is seriously under threat: the rate of species extinction has been greatly accelerated by human activities, particularly in island nations across the globe.

Within the environmental context of Kiribati as a small atoll nation, biodiversity includes all terrestrial and marine ecosystems, all plant and animal species and varieties found in these ecosystems, and the traditional knowledge, uses and beliefs and local language that people have in relation to these ecosystems and species. These knowledge systems have enabled the people of Kiribati to live harmoniously with their environment (on land and at sea) and survive in their limiting environmental conditions for many generations. Local people rely heavily on biodiversity-based resources that support their small-scale income-generating activities as well as forming the basis of their cultures in terms of traditional health care, magic and sorcery, traditional building infrastructure needs, etc. The Government of Kiribati relies heavily on marine biodiversity, especially resources such as the tuna fisheries, as the major source of foreign cash revenues. Sadly, a large proportion of biodiversity on land and at sea in Kiribati is seriously threatened and in need of protection at the national level.

To effectively conserve biodiversity and its critical functions as a whole, conservation action must focus on two key components: individual species in need of conservation, and specific sites and landscapes that are most important for their persistence. Using a transparent, data-driven process to identify these conservation targets allows for the efficient allocation of scarce conservation resources. These targets also provide a baseline against which the success of biodiversity conservation interventions can be measured.

Kiribati is part of the Polynesia-Micronesia Biodiversity Hotspot, one of 34 regions of the world where extraordinary levels of biodiversity and endemism (i.e., species unique to a known and defined area) are coupled with extremely high levels of threat (Mittermeier et al 2004). Although 90 species found in Kiribati are listed as globally threatened on the currently available International Union for Conservation of Nature and Natural Resources' (IUCN) 2010 *Red List of Threatened Species* (www.iucnRed List.org), the true number of threatened species in Kiribati is significantly higher than this. The primary threats to Kiribati biodiversity are habitat alteration caused by unplanned or poorly planned development (especially causeway construction), overharvesting of resources (e.g., overfishing, gleaning, and harvesting of mangroves), waste and pollution, modern agricultural methods, and the spread of invasive species.

Site-based conservation is one of the most important and successful tactics for reducing global biodiversity loss. Governmental commitments to site conservation include Kiribati's National Biodiversity Strategy and Action Plan (K-NBSAP), which commits Kiribati to meeting the Convention on Biological Diversity (CBD) goals of 10% land and marine area conserved by 2020. The Government of Kiribati is a CBD signatory which enjoins parties to establish "a system of protected areas or areas where special measures need to be taken to conserve biological diversity". Safeguarding these key areas requires a variety of governance approaches, including conventional protected areas (PA), community conservation areas (CCAs), co-managed sites, and large multi-ecosystem areas like the Phoenix Island Protected Area (PIPA). The best approach will vary from place to place depending on the context and community needs. A network of such sites, coupled with species-specific actions and anchored within a matrix of compatible land uses, provides the best way to ensure the conservation of locally and globally important biodiversity.

The Key Biodiversity Area (KBA) approach presents an appropriate framework for pinpointing site-level conservation targets and priorities in Kiribati. The KBA approach builds on and complements the conservation priority setting approaches completed for Kiribati including the NBSAP and the current conserved areas of PIPA and *motus* (small islets or islands) on Kirimiti Island. This method identifies sites that contain species most at risk of extinction and thus are priority sites for conservation at a global as well as a national level.

KBAs as sites of global significance for biodiversity conservation are identified using transparent, globally standard criteria (Langhammer *et al* 2007). The KBA concept extends to all taxonomic groups, and the same data-driven methodology is employed by Bird Life International and Plantlife International, which have used the approach to identify Important Bird Areas (IBAs) and Important Plant Areas (IPAs), respectively. KBAs can be used as a tool by governments, intergovernmental organizations, nongovernmental organisations (NGOs), the private sector, and other stakeholders to expand the PA network in Kiribati, and, more generally, for targeting conservation action. Additionally, KBAs provide the building blocks for landscape-level conservation planning and for maintaining effective ecological networks aimed at preventing biodiversity loss.

Key Biodiversity Areas (KBA): Approach and Criteria

There are many approaches to systematic conservation planning (Margules & Sarkar 2007). The KBA approach is a data-driven, replicable methodology well suited to assessing biodiversity, because it addresses extinction as the mechanism through which

biological diversity is lost and targets habitats critical to the survival of species most at risk of extinction. The ultimate goal of the KBA identification process is to identify and define a critical network of sites which, if protected, will conserve sufficient habitat to avoid future extinctions. In KBA terms, a "site" means an area of any size identified on the basis of biological criteria that can be delimited and potentially managed for conservation. In Kiribati, the small island/big ocean context means a "site" is identified as a whole island, recognizing that most KBA trigger species have movement patterns and habitat ranges at an island scale. This is the same site unit recommended by the Kiribati Important Bird Areas (IBAs) analysis done in 2007 (Gupta 2007). During the implementation phase, zonation within the island sites will be undertaken to account for various local use and conservation needs.

Table 1 lists the criteria utilized for identifying KBAs. Identified KBAs are further prioritised using the criteria of **vulnerability** and **irreplaceability** (Langhammer *et al* 2007). The vulnerability criterion identifies island sites important for species that are at the most immediate risk of extinction, while sites meet the irreplaceability criterion if they hold geographically concentrated species - that is, those with few spatial options for their conservation.

> **Vulnerability** (or threat of extinction) *refers to the likelihood that a site's biodiversity value will be lost in the future* (Pressey & Taffs 2001). *Highly vulnerable sites are the most urgent priority sites for conservation. Sites facing low threat of extinction will retain options for conservation in the future. Vulnerability may be measured on a site basis (likelihood that the site will change with loss of habitat and associated species) or a species basis (likelihood that species within the site will become extinct).*
>
> **Irreplaceability** (or uniqueness) *of a site is the degree to which geographic options for conservation will be reduced if that particular site is lost (Pressey et al 1994). In an extreme example, a site is completely irreplaceable if it contains one or more species that occur nowhere else. In contrast, when sites contain only species that are widely distributed, many alternatives exist for conserving these species. Sites that hold significant fractions of a species' entire population during particular periods of the year (e.g., migratory bottlenecks and routes) are also highly irreplaceable. (*Langhammer *et al* 2007*).*

CRITERIA	SUB-CRITERIA	PROVISIONAL THRESHOLDS FOR TRIGGERING KBA STATUS
Vulnerability Regular occurrence of a globally threatened species (according to the IUCN Red List) at the site		Regular presence of a single individual for Critically Endangered (CR) and Endangered (EN) species; Regular presence of 30 individuals or 10 pairs for Vulnerable species (VU)
Irreplaceability Site holds 5% of a species' global population at any stage of the species' lifecycle	a) Restricted-range species	Species with a global range less than 100,000 km^2; 5% of global population at site
	b) Species with large but clumped distributions	5% of global population at site
	c) Globally significant congregations	1% of global population seasonally present at site
	d) Globally significant source populations	Site is responsible for maintaining 1% of global population

Table 1. Criteria for the identification and delineation of Key Biodiversity Areas (KBAs). Adapted from Langhammer et al (2007).

The focus is first on globally threatened species as defined by the IUCN Red List, and then on restricted range species with limited spatial options for conservation. Bioregional restricted assemblages add sites with unique biological communities that are not captured with the previous two criteria, (e.g., the vegetation of atolls in different climatic zones of the three archipelagoes). Finally sites which host significant global congregations of one or multiple species populations, (e.g., seabirds or migratory waders, are added to the set of KBAs. The application of criteria is dependent on having sufficient data to justify the assignment of one or more of the criteria to a site, and if the data is lacking or over 20 years old, the site can only receive 'candidate' status pending verification through field surveys.

If sites are to prevent biodiversity loss, they must safeguard those species facing highest extinct risk. Due to the need to safeguard sites where globally threatened species occur, the vulnerability criterion is applied before the irreplaceability criterion when identifying KBAs (Langhammer et al 2007). Therefore the first task in identifying KBAs is determining which globally threatened species occur in the desired country or region. The IUCN Red List provides the best source of information on threatened species within a country. The threatened species list information is supplemented in some cases by national and taxonomic data bases, as well as through the primary literature and direct consultation with specialists and experts (Langhammer *et al* 2007).

Aerial photo of Kiribati. *Photo © by S van Dijken*

Identifying and Delineating KBAs in Kiribati

In 2003, Conservation International's Pacific Islands Program (CI-PIP) initiated a process to identify terrestrial conservation targets for the Polynesia-Micronesia Hotspot, which included Kiribati. This analysis was carried out in collaboration with the Secretariat for the Pacific Regional Environment Program (SPREP), the Bishop Museum, The Nature Conservancy, Societé d'Ornithologie de la Polynésie, and the Wildlife Conservation Society. Numerous other institutions and experts also provided data and reviewed the results of this analysis. A total of 162 KBAs were identified for the Hotspot during this analysis, including 3 KBAs in Kiribati (Mittermeier *et al* 1999).

In 2010, CI and SPREP began collaboration with the Kiribati Ministry of Environment, Lands and Agriculture Development (MELAD), under Kiribati's Programme of Work for Protected Areas (PoWPA) phase II and with funds provided by the Global Environment Facility (GEF) through the United Nations Development Programme (UNDP), to conduct an ecological gap analysis (GA) for Kiribati. The main purpose of the GA was to analyse how effective the current Protected Area (PA) network is in achieving Kiribati's NBSAP conservation targets, and in particular to identify priority areas for the expansion of the PA network and priority actions for improved management of existing PAs. A complimentary objective was to identify the key gaps in our knowledge of biodiversity.

A total of 22 KBAs were identified (encompassing marine and terrestrial systems) during this process, and conservation targets were established for all native ecosystems.

The main challenge in identifying KBAs was to refine the results of previous surveys: specifically to identify and map threatened species of corals, fish, birds, reptiles, mammals and plants; to document the presence of these species in existing sites; and to identify new KBAs where needed. The 2010 IUCN Red List provided a list of 90 threatened species for the country, as well as basic data on their conservation status, distribution, threats, and key contacts and references. An additional ten species known to be threatened in Kiribati, but not listed on the 2010 IUCN Red List, were also used for KBA identification. Appendix A, Table A provides the list of 100 targeted species that were used in this analysis. Appendix A, Table B lists species of local Kiribati concern. Several species of cultural importance were additionally considered as priority species (see Appendix B). It is important to note that there are many species known to occur in Kiribati waters that are threatened but have not been assessed and listed for the country and thus do not appear on the Kiribati Red List. Furthermore, many species such as sea cucumbers and some shark species that are known to be threatened have not been currently assessed on the IUCN Red List and therefore are not included in official KBA analysis, but do help with KBA area justifications.

Geographic locality data for each trigger species were obtained from surveys, published literature, unpublished reports, and personal communication with regional experts. The data for marine resources is particularly limited for point locality data in the Gilbert archipelago and northern Line Islands; therefore, habitat was used as a proxy to estimate species presence when considering a network of PA. PA site selection included the entire island as well as an area extending 100m offshore from the reef crest. This included all habitats from the near shore area, out past the reef crest to a maximum distance of 100m offshore.

Due to the archipelagic nature of Kiribati, the sharp distinction between islands and island groupings, and limited vegetation and flora, the KBA methodology was applied to each Kiribati archipelago (Gilbert, Phoenix, and Line Islands) with KBA sites identified to the island scale including all habitats within 100 meters offshore of each island. Specifically, this analysis included terrestrial, coastal and lagoon habitats within the aforementioned zone and excluded deep sea and open ocean habitats. Furthermore, the following spatial data layers were used: geographic locations of IUCN Red Listed species; protected areas and other land management units; IBAs; data on habitat type and extent; and reef cover. IBA boundaries were modified as needed to incorporate habitat important for non-bird trigger species, and to incorporate management data. Some IUCN-listed migratory species which depend on island habitats, such as turtles and sharks, were also included as trigger species to identify KBAs.

While this first-cut marine KBA analysis focused on territorial seas, the offshore areas in Kiribati's Exclusive Economic Zone (EEZ) require analysis and conservation management as well. However, datasets for the offshore environments, especially for the Gilbert and Line Island groups, including deep sea and open ocean habitat, are currently very limited and therefore could not be included in this analysis.

Experts and interested members of the public reviewed the preliminary KBAs during several informal meetings, and during formal workshops held with key stakeholders (e.g., K-NBBSAP working group, MELAD, Culture ministry) in Tarawa on November 10, 2011. Modifications to proposed sites were made based on recommendations at these meetings. Since KBA identification and delineation is an iterative process, the boundaries will be modified and new KBAs added as new data become available.

The EEZ of Kiribati encompasses nearly 3.5 million square kilometers of water. The territorial seas (12nm offshore) which included the focus area for this analysis cover about 78,000 km^2. The 22 identified KBAs cover an approximate total area of 4,000 km^2 or approximately 74% of the country's total land, lagoon and near shore habitat of Kiribati and representing the majority of terrestrial, mangrove, lagoon and reef habitat types in the country (see Map 2, Map 4 and Map 5). The combined area of the top priority sites, one from each of the three archipelagos, is equivalent to 21% of the total area of the reefs and land of Kiribati.

Currently, 12 of the 22 KBAs have been completely or partially established as conservation areas by the government of Kiribati or by local village communities. Most of the protection by area is within the Phoenix Island Protected Area (PIPA) that has a functioning management plan and is funded through a trust. The total area protected by PIPA encompasses 408,250 km^2 of ocean. There are six individual motus on Kiritimati and three designated special bird areas in the southern Line Islands that also have official protection

Kiribati traditional dancing and costume: The people of Kiribati used their natural resources to make their typical traditional dress using their traditional knowledge. How they make it reflect their interacting with their environment and those resources that they live with every day. Most of the dancing costumes are typically from coconut, pandanus, salt bush and beach morning glory tree while the rest were from the marine environment like shells. *Photo © by Tony Whincup*

(i.e., Vostok, Malden and Starbuck). However, management effectiveness of currently protected sites is highly variable and many need improved management to adequately safeguard their biodiversity.

The remaining KBAs lack formal protection. These sites are targets for the expansion of the PA network. Some species that remain at risk due to these protection gaps (i.e. threatened species that have only been recorded on these gap islands) include Bigeye Tuna (*Thunnus obesus*, recorded only on Tarawa), and coral species Acropora echinata (*procumbens*), Acropora vaughani, Alveopora verrilliana, and Montipora patula, all recorded only on Tabuaeran.

Given that funding for conservation investment is limited, and that some KBAs require safeguarding more urgently than others, prioritization amongst the KBAs identified within each archipelago is important. KBAs can be prioritized according to their irreplaceability and vulnerability, the same principles involved in their identification. Prioritization of KBA sites is presented here and is sufficiently detailed to focus effort on the most important sites in Kiribati; protecting localized sites on islands will require the involvement of the Island Council and potentially additional biological and socioeconomic data.

Did you know?

- The Republic of Kiribati is an ocean and island nation stretching over 3,500,000 square kilometers in the central Pacific Ocean. The three archipelagos that make up the land area of Kiribati total a land area of 811 square kilometers, a mere 0.023% of the sea area. Kiribati is truly a LARGE OCEAN STATE!

- The island of Banaba, which is the only raised coral island (87m above mean sea level) in Kiribati and one of the three large phosphate rock islands in the Pacific, forms the highest point on Kiribati. The other two large phosphate rock islands are Makatea in French Polynesia, and Nauru.

- Kiribati is the only country in the world to fall in all hemispheres – northern, southern, western and eastern.

- Kiribati has more than 1500 described species. This includes 567 species of fish, 361 species of coral, 289 invertebrate species, 275 species of plants, 51 species of birds, 26 mammal species, including 20 marine mammal species, and eight species of reptiles including the critically endangered hawksbill turtle.

- The 90 species in Kiribati that are classified on the 2010 IUCN Red List as threatened species include 72 corals, nine marine fish, six birds, two turtles, a giant clam and a mammal. Many more species are believed threatened but have not yet made it onto the IUCN Red List, or are on the list but not classified as threatened.

Kiribati Setting

Geography, geology and climate

The small island/big ocean nation of Kiribati consists of 32 low-lying coral islands and one raised limestone island scattered 3.5 half million km^2 of EEZ in the Central Pacific, between latitudes 4° N and 3° S, and longitudes 172° E and 157° W (Map 1). Kiribati is truly an ocean nation, featuring three island groups; the Gilbert Islands, Phoenix Islands, and Line Islands. The total land area is 810.8 km^2 (Tebano 1999, Thomas 2002).

The Gilbert Islands group consists of 17 islands (including Banaba); with a total land area of 285.7 km^2. Tarawa Atoll, in the Gilbert group and the location of the capital, consists of more than 20 named islets, the southern six of which are linked by causeways. The distance between Tarawa and outer islands in the Gilbert group ranges between 51 km and 600 km (Thaman and Tebano 1995). Most of the islands are not more than 2 km wide, or more than 6m above sea level, except Banaba in the Gilbert group which rises to 87 m above mean sea level.

The Phoenix Islands group consists of eight largely uninhabited islands; with a total land area of just 28.6 km^2, located some 1,750 km east of Tarawa. The only inhabited island of the Phoenix group is Kanton (Canton) Island with a land area of 9 km^2.

The Line Islands group also consists of eight islands; with a total land area of 496.5 km^2 extending over a north-south distance of 2,100 km and located at a distance of between 3,280 and 4,210 km east of Tarawa, and some 800 km south of Hawaii. This group includes Kiritimati, the largest island in Kiribati with an area of 388.4 km^2.

Vegetation

The indigenous flora and vegetation of Kiribati is among the poorest and least diverse on earth (MELAD, 2006). In the Gilbert Islands and some locations in other inhabited islands, this flora has been severely modified or removed. Generally, terrestrial vegetation in Kiribati is limited to coastal strand vegetation, mangroves and limited coastal marsh vegetation, inland forest, and pinnacle vegetation on limestone escarpments (MELAD 2006).

People and Resource Uses

The natural resources of Kiribati are either extremely small in scope, in the case of terrestrial, lagoon and nearshore resources, or extremely vast and difficult to utilize and manage, in the case of its oceanic marine and seafloor resources within its extended EEZ. These resources and the environment have shaped I-Kiribati life ever since the first settlement of the Kiribati atolls (MELAD 2007a, 2007b).

The marine resources provide the main source of protein for the I-Kiribati, and generate income for households and villages, and revenue for the country. Despite the limited terrestrial resources, the people of Kiribati have developed ecological, social and economic needs based on these resources. The main export commodities include copra, live fish and seaweed (MELAD 2007a).

Climate Change

Kiribati is one of the most vulnerable countries in the world to the adverse impacts of climate change. The atolls of Kiribati on average rise 3 – 4 meters above mean sea level and are no more than 2 kilometers wide. These atolls are the home of over 100,000 Kiribati people with their own distinct culture. Inundation and erosion destroy key areas of land and vegetation within the already small land area and limited vegetation of each atoll, and storm surges contaminate the fresh groundwater lens which is vital for health and survival. Impacts of ocean acidification are projected to increase with climate change, posing adverse risks to the health of the coral reef ecosystems and other marine fauna and flora.

An economic evaluation of the costs of climate change related risks has been estimated to be 35% of Kiribati's gross domestic product (GDP) (MELAD 2007a). The estimate takes into account only the potential impacts of climate change on coastal zone (US$7–$13 million/year) and water resources (US$1–$3 million/year). In 1998 the GDP was US$47 million (The National Integrated Environment Policy, MELAD 2007a).

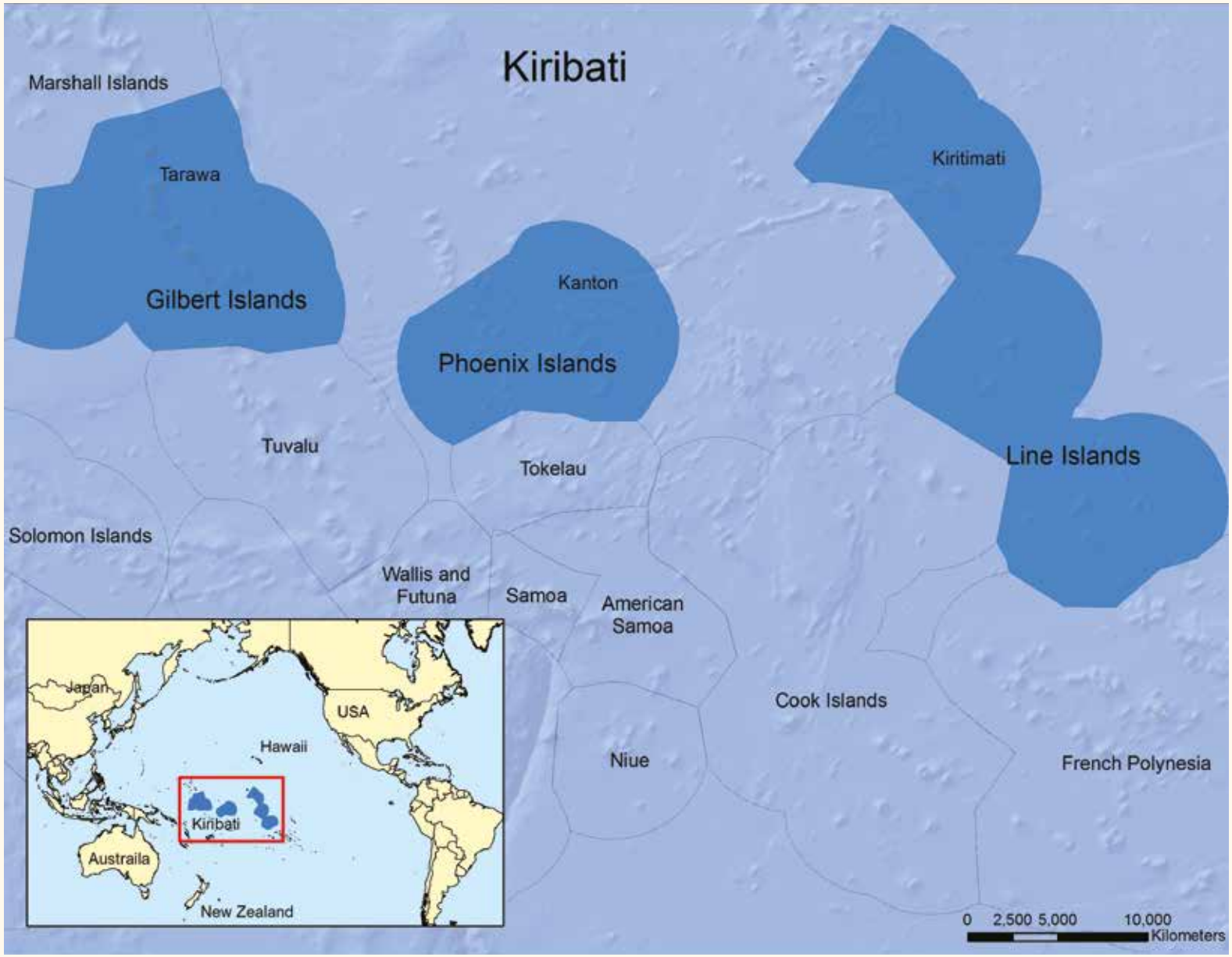
Threats to Biodiversity

While biodiversity provides the services critical to Kiribati's economic, cultural and social wellbeing, it continues to face imminent threats both from human and natural causes. This section highlights the key threats impacting biodiversity.

Based on various national, outer islands, and household surveys undertaken as part of the formulation of the Kiribati National Biodiversity Strategies and Actions Plan (K-NBSAP) from 1996 – 2004, it has been confirmed that the present state of biodiversity in Kiribati is being socially, economically, politically and even judicially degraded. The main threats associated with this degradation include climate change, pollution (i.e., water and land), deforestation, overfishing, invasive species, overpopulation, and infrastructure developments. The main driver for the identified threats is rapid urbanization, particularly on the capital island of South Tarawa. South Tarawa has one of the highest population densities in the world, with 3,184 people per km^2.

Over exploitation and unsustainable harvesting practices: Largely due to overpopulation and uncontrolled urban drift experienced in Kiribati, especially within the capital of Tarawa, the demand to consume natural resources is high, and some resources are overexploited. This includes the overexploitation of fisheries resources (e.g. seaweeds, finfish, bêche-de-mer, crabs and lobsters, shellfish, corals and other marine invertebrates) whose use was formerly restricted for local subsistence consumption, but is now rapidly expanding to commercial production for local and export markets. Overexploitation is often associated with the use of more efficient and modern fishing technologies (i.e., better motorized boats, improved spear guns and line fishing methods, improved refrigeration and distribution, more efficient nets, and night spear fishing using SCUBA or hookah).

Map 1: Kiribati Island Groups



Waste and Pollution: In Kiribati, the majority of waste is plastic, clothing, bottles, oils and cans, and waste management remains a challenge. Furthermore, bacterial contamination in the near-shore waters of Tarawa lagoon, nuclear pollution, and disposal of hazardous waste by industrial nations in the shared oceanic environment create problems for human populations as well as the environment. Furthermore, most of the population now depends on imported food; thus, the production of non-recyclable rubbish, especially plastics, is high. Major government owned reclaimed areas have been developed in South Tarawa in an attempt to deal with this problem.

Water pollution is also of concern, and this often refers to the oil spillage and other common forms of ocean dumping. Some cultural practices, such as pig keeping, are also impacting water quality. It is anticipated that more than 90% of households in Kiribati contain a pigsty that, when managed improperly, deteriorates the water quality (both underground water lens and inshore reefs). Similarly, there have been documented cases of deliberate oil release by private bus companies in Tarawa. Fortunately, these actions were quickly controlled by the Environment and Conservation Division; however, it is believed that some environmental damage was already done.

The Government of Kiribati, through the Environment and Conservation Division (ECD), has regulated and is slowly controlling waste and pollution issues through the Environment Amendment Act 2007. However, the limitation of this Act is that its pollution provisions (on land) are mostly exclusive to Tarawa.

Invasive Species: Invasive species, especially rats and feral cats, are a great threat to the ecological balance in vulnerable small Pacific Islands. In Kiribati, invasive species exert a costly toll on biodiversity and on human economies that depend on resources and services provided by healthy ecosystems. Agriculture is still predominantly subsistence, based on both traditional and introduced food crops and livestock. Already, prospects for development in the agricultural and fisheries sector are constrained by the country's naturally harsh environment, which is further compounded by smallness, fragmentation and livestock. (MELAD, 2007) The presence and persistence of invasive alien species in Kiribati exacerbates the national situation, where agriculture and fisheries development is concerned. For example, Kiribati fisheries authorities have confirmed that introduced tilapia has been predating on the popular milkfish in fish farms throughout the Gilbert Islands including Tarawa (Akoako, 2004). Other invasive alien species currently existing in Kiribati include Pacific or Polynesian rat (Rattus exulans; Ship rat (Rattus rattus); House mouse (Mus musculus); and feral cats (Felis catus) (these first four species being detrimental to sea bird populations and sea turtle eggs); wedelia (Wedelia trilobata, creeping mat-forming herb); mynah birds (Acridotheres tristis), and more recently discovered unknown catfish species in Tarawa lagoon believed to have come from foreign ship ballast water, and suspected of predating on lagoon finfish (Akoako, 2004).

1: Aerial photo of Abaiang *Photo © by Tony Whincup*

2: Copra is a popular income generating activity in Kiribati. There was a Kiribati Copra Mill Company located at South Tarawa where copra from all over the three regions of the Kiribati Islands were being shipped to and processed to make soap, body oil, cooking oil and where the residue were used as pig food and for cooking. The coconut tree is the father of all trees in Kiribati, it has lot of traditional, socially and economic uses to the people and the land itself.
Photo © by Tony Whincup

3: This picture is taken on the Islet of Takaeang in Aranuka where the people of Islet are planting mangroves as part of the Kiribati Adaptation Plan phase II Project. This will assist with coastal protection. The area is very rich in marine resources and the people here hope to make the area a MPA.
Photo © by MELAD

4: On the mainland of Aranuka, the strand of coconut trees being planted in rows. Coconut planting on this island is very common and people used to plant their coconut trees on their own land this way. When the first row of coconut trees were old and does not produce further coconut fruit, they cut them down and replant one in replacement of those old ones. You can see that the first row are taller than the third row. *Photo © by MELAD*

5: WWII relics on Tarawa, Kiribati. *Photo © Jonny Lewis.*

Gilbert Islands

Setting

The Gilbert Islands group consist of 17 small islands that extend approximately 640 km from north to south and are located between 3º30'N to S 2º45'S and 172º30'E to 177º00'E, with a total land area of approximately 279 km^2. From north to south the atolls in the group are: Makin, Butaritari, Marakei, Abaiang, Tarawa, Maiana, Kuria, Aranuka, Abemama, Nonouti, Tabiteuea, Onotoa, Beru, Nikunau, Tamana, and Arorae. To the west of the coral atolls lies Banaba island, which is a raised limestone island rising to a height of 87 meters. Over 90% of the country's population lives in the Gilbert group, particularly on Tarawa (MFED 2010). As of the 2010 census, the population of the Gilberts was 93,801, with 54% of this population living on Tarawa. With the exception of Tarawa, Abaiang, Tabiteuea and Butaritari, all islands have populations under 4,000. The average population growth rate is estimated at 2.2%. The average population density over the whole country is 272 people per square kilometre. However, on South Tarawa alone, it is about 3,184 people per square kilometre (MFED 2010).

Annual rainfall increases from south to north. While this can be linked to increased food productivity in the north, all atolls depend on healthy ecosystems for a sufficient supply of primary food. The health of marine ecosystems, especially those linked to the diverse habitats found in lagoons, are important for a stable supply of protein for local populations. Because many households depend on fishing for either income or subsistence, healthy atoll ecosystems, as indicated by the status of biodiversity, are vitally important.

Current Conservation Effort

There are currently no actively managed conservation areas in the Gilbert Islands. There have, however, been efforts in the recent past, including the North Tarawa Conservation Area (NTCA) which was officially established in 1996. The stated purpose of the NTCA was "the encouragement of sustainable development while simultaneously protecting important terrestrial and marine ecosystems and species (DESD 1995). It was selected for designation as a conservation area both for its range of habitats and high biodiversity and for its proximity to South Tarawa, which because of its high population density exerts strong pressures on non-local resources.

The reasons the NTCA was first established are still valid. Furthermore, lessons learned from the attempt to sustainably manage the NTCA will be important both for possible reconsideration of this area as a viable conservation area and for the planning of other managed areas in the future.

Literature Review Summary

The Gilbert Islands literature review began with a bibliography of 421 technical reports and academic articles on Kiribati that was compiled by Reefbase under the supervision of Pip Cohen. Of these, 75 (or approximately 18%) dealt with the Gilbert Islands or a subset of islands within the archipelago. This subset was then sorted by title. All obviously irrelevant documents were excluded. For example, the report "Reconnaissance survey of coastal erosion sites in the Gilbert Islands group, Republic of Kiribati (Phase II)" was eliminated. Other examples include documents about sea mining, legal frameworks, and economic development. Next, all possibly relevant articles were subject to database searches utilizing Reefbase, Secretariat for the Pacific Regional Environment Program (SPREP) library databases, Secretariat of the Pacific Community (SPC) and the Applied Geosciences and Technology Division of the SPC (SOPAC) archives, and Google Scholar. Difficult-to-find documents of probable value were subject to more extensive research in collaboration with the SPREP librarian. Pacific Regional Oceanic and Coastal Fisheries Development Programme (PROCfish) data, data provided by the Government of the Republic of Kiribati, and several dozen additional documents were subsequently added to the set reviewed. The resulting list was read and data regarding the number and location of Kiribati Red List species and species of local concern were extracted. In total, 25 data points within the Gilbert Islands were located.

This process presented several challenges that should be noted. First, relative to the Phoenix and Southern Line Islands, the research literature on the biodiversity of the Gilbert Islands is sparse. Second, the majority of documents on this region's marine life regard species of economic or subsistence value. Finally, most of the documents reviewed either lacked species level information (e.g. giving only the genus), gave insufficient location data, or both. Although this state of the data should not impede conservation efforts, the gaps mentioned above suggest that further research will make the identification of KBAs easier and more precise.

KBA Results Based on IUCN Red List Criteria Alone

According the criteria guidelines for recommending KBAs as set forth by the Guidebook for the identification, delineation and prioritization of key biodiversity areas (Conservation International, 2008), the presence of either Critically Endangered (CR) or Endangered (EN) species automatically triggers the delineation of a KBA. Map 2 shows that seven islands (i.e., Abaiang, Kuria, Abemama, Nonouti, Tarawa, Makin and Tabiteuea) meet this criterion and are recommended as KBAs. Furthermore, ten or more pairs of Vulnerable (VU) species also trigger a KBA. Because of the unique challenges of marine species surveys and the likelihood that more species are present than could be visually verified, the presence of twenty or more individuals is taken to indicate ten or more mating pairs. Three islands (i.e., Abemama, Kuria, and Tabiteuea) meet this criterion where there have been sightings of 10 or more pairs of Chelinus undulatus and Plectropomus areolatus. A visual map of IUCN Red Listed species numbers can be found in Map A in Appendix A.

Given the current KBA criteria guidelines, seven KBAs are recommended for the Gilbert Islands group. From north to south in the archipelago these are: Makin, Abaiang, Tarawa, Abemama, Kuria, Nonouti and Tabiteuea.

Map 2: Gilbert Islands.
Note: pictures taken from Google Earth satellite images.

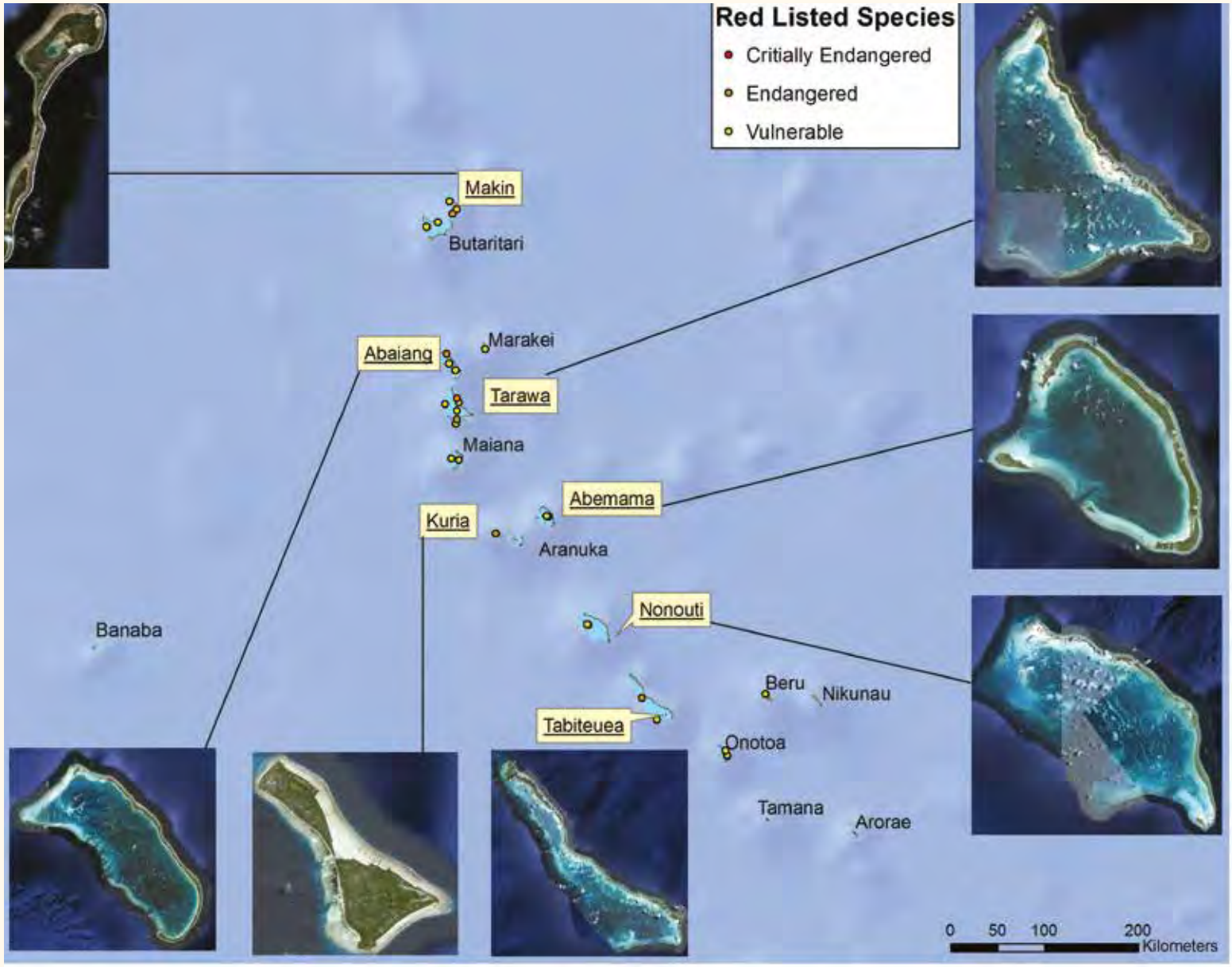


Table 2: Number of KBA trigger species for the Gilbert Islands

RANK	SITE NAME	CR	EN	VU	IBA – A4 CATEGORY [1]
1	Abaiang	-	2	3	-
2	Abemama	-	1	3	-
3	Nonouti	1	-	1	-
4	Tabiteuea	-	1	1	-
5	Tarawa	-	1	2	-
6	Makin	-	1	1	-
7	Kuria	-	1	-	-
8	Butaritari	-	-	1	-
9	Onotoa	-	-	2	-
10	Maiana	-	-	1	-
11	Marakei	-	-	1	-
12	Beru	-	-	1	-
13	Aranuka	-	-	-	-
14	Tamana	-	-	-	-
15	Arorae	-	-	-	-
16	Nikunau	-	-	-	-
17	Banaba	-	-	-	-

[1] There has been no IBA study done, and therefore no data exist for this category for the Gilbert Islands. Note. Names of actual species listed here are provided in Gilbert Island KBA Profile Table (Table 3).

Recommendations based on areas and species of local expert concern.

The Kiribati NBSAP identifies many species that are of local concern due to overharvesting, or are of horticultural interest, degraded habitat and/or cultural importance. Furthermore, the PoWPA working group has identified areas of concern to be documented on many of the Gilbert Islands atolls. Including these areas and additional criteria in the designation of KBAs is important for several reasons. First, as noted in the literature review section, significant biodiversity research gaps exist for the Gilbert Islands. This increases the likelihood that important biodiversity areas will be ignored due to the limited research attention to biodiversity in this island group. The consideration of species of local concern increases the chance that locally recognized trends and threats will be incorporated into the site selection. Second, according to IUCN Kiribati summary of species on the 2010 Red List, gaps exist in the Red List itself with regard to the Pacific region in general and Kiribati in particular. These gaps are especially significant for marine species, with only 11% of known fish having been assessed, as well as plant species, with no plants having been assessed. This also increases the chances that significant biodiversity areas will be overlooked. While species of local concern do not factor into the current KBA criteria, the inclusion of locally important species may be important not only as incentive for sustained community engagement but also as a means of linking biodiversity conservation with immediate, social issues such as food security.

Map 3 shows the areas of significance that have been identified by local experts (MELAD staff, Kiribati Museum staff, Natan Itonga) on all islands with the exceptions of Kuria and Abemama. Species of local concern have been identified on all islands with the exceptions of Nikunau and Tabiteuea. Table B in Appendix A provides a detailed list of these species by island. Furthermore, Appendix B outlines additional Areas of Local Biocultural Concern that have been identified. It is a finding of this report that significant knowledge gaps also exist regarding the local valuation of species suggesting that additional community engagement is needed within all KBAs to further utilize local knowledge of these species.

Recommendations Based on Habitat Indicators

There are important reasons for considering habitat indicators when evaluating potential sites for KBAs. Among these is the generally thin research base available on the Gilbert Islands (see above). It is also important to note, however, that even the existing research is not evenly distributed across all atolls. This suggests that these indicators do not afford an adequate means of comparing atolls. The habitat indicators provided below provide grounds for evaluative consistency across the archipelago while also adding to our knowledge of each island's potential for biodiversity.

Each island has varying levels of habitat. These range from simple fringing reefs to more complex lagoon systems. Generally greater habitat complexes relates to higher potential biodiversity. The following habitat indicators have been analysed for each atoll:

Geomorphic classes: A geomorphic feature or structure type ranging from reef flat to deep lagoon, used here as a proxy for habitat diversity. A greater the number of geomorphic classes present in one atoll complex suggests greater potential habitat diversity, thus greater potential for biodiversity. The number of classes throughout the archipelago ranges from 3 to 12. Butaritari has the greatest number followed closely by Tabiteuea.

Pinnacles: A small, isolated spire of rock or coral, especially a small reef patch, Pinnacles create vertical habitat structure in low wave energy environments and contribute to higher habitat diversity. Nonouti and Tabiteuea lead this metric.

Lagoon area metric: Because all islands have reef crest and slope habitats, the presence of a lagoon increases habitat diversity. Larger lagoons have the potential for more complex ecosystems and habitat complexes. Tabiteuea, Butariari, Nonouti and Tarawa lead this metric.

Passage area: Greater connectivity between the ocean and lagoon environments indicates better exchange of biota and nutrients. Nonouti and Tabiteuea lead this metric.

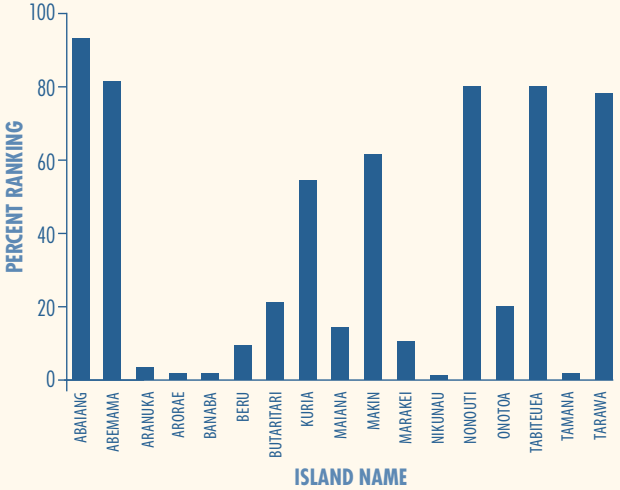
A summary of these criteria for Gilberts can be found in Graph A and Table C in Appendix A. Generally, Butaritari, Tabiteuea and Nonouti show highest scores for habitat diversity and thus strongest potential to become KBAs.

Collecting Toddy: using traditional knowledge to harvest coconut sap from the emerging flowering coconut spathe. Toddy is the main drink for the people of Kiribati and it is common for everyone to collect toddy every morning and evening, sometimes during the day as well so that you can produce more toddy juice.
Photo © by Widescenes Photography

Ranking

From all the available data that has been gathered for each island in this analysis, including number of IUCN Red Listed species, number of automatic KBA trigger species (species that are listed as Critically Endangered or Endangered) and geomorphic values, a ranking calculation was created. A formula was used that took each category above and standardised values amongst each Gilbert Island to obtain a final ranking percentage for within the archipelago. Heavy weight was given to number and presence of automatic KBA trigger species (45%), followed by total number of IUCN Red Listed species (35%), and finally by geomorphic score for each Island (20%). Figure 1 illustrates the comparison of KBA rankings for all Gilbert Islands.

Figure 1: Gilbert Island KBA ranking



Summary and Recommendations

Table 3 provides a summary of recommended KBAs for the Gilbert Islands group. In several cases the recommendations of experts, local interests and habitat considerations have strengthened the suggestions made using the current IUCN KBA criteria alone. However, several other islands can also now be recommended for KBA status based on additional considerations that have been assessed.

The KBA area calculated here includes terrestrial, lagoon, and reef habitats out to the 100m depth profile. More research will be needed within each island scale KBA for more detailed resolution.

Table 3: Profile of Key Biodiversity Areas in Gilbert Islands

SITE KBA PRIORITY NUMBER	SITE NAME	APPROXIMATE AREA (KM²)	CURRENT PROTECTION STATUS	TRIGGER SPECIES IN SITE	THREATS
1	Abaiang	399	Proposed: Abaiang lagoon	Green Turtle (*Chelonia mydas*), Humphead Wrasse (*Cheilinus undulates*), Polkadot Cod (*Plectropomus areolatus*), Blacksaddled Coral grouper (*Plectropomus laevis*), Giant clam (*Tridacna gigas*)	Pollution from human settlement and human waste, piggery waste, overextraction of marine resources and loss of traditional land use.
2	Abemama	294	N/A	Humphead Wrasse (*Cheilinus undulates*), Polkadot Cod (*Plectropomus areolatus*), Blacksaddled Coral grouper (*Plectropomus laevis*), Giant clam (*Tridacna gigas*)	Pollution from human settlement and human waste, piggery waste, overextraction of marine resources and loss of traditional land use.
3	Nonouti	681	Noumatong, Tabontenaa	Hawksbill (*Eretmochelys imbricata*), Giant clam (*Tridacna gigas*)	Pollution from human settlement and human waste, piggery waste, overextraction of marine resources and loss of traditional land use.
4	Tabiteuea	782	Proposed Western reefs	Humphead Wrasse (*Cheilinus undulates*), Giant grouper (*Epinephelu lanceolata*)	Pollution from human settlement and human waste, piggery waste, overextraction of marine resources and loss of traditional land use.
5	Tarawa	563	Proposed: North Tarawa lagoon	Green Turtle (*Chelonia mydas*), Bigeye Tuna (*Thunnus obesus*), Humphead Wrasse (*Cheilinus undulates*), Giant clam (*Tridacna gigas*)	The island is inhabited with 45,000+ people and is expected to continue growing. Human presence has been associated with decline of species, particularly through the introduction of alien species, and through housing, development and overfishing.
6	Makin	23	Proposed: Makin Islet	Green Turtle (*Chelonia mydas*), Giant clam (*Tridacna gigas*)	Pollution from human settlement and human waste, piggery waste, overextraction of marine resources and loss of traditional land use.
7	Kuria	73	N/A	Humphead Wrasse (*Cheilinus undulatus*)	Pollution from human settlement and human waste, piggery waste, overextraction of marine resources and loss of traditional land use.

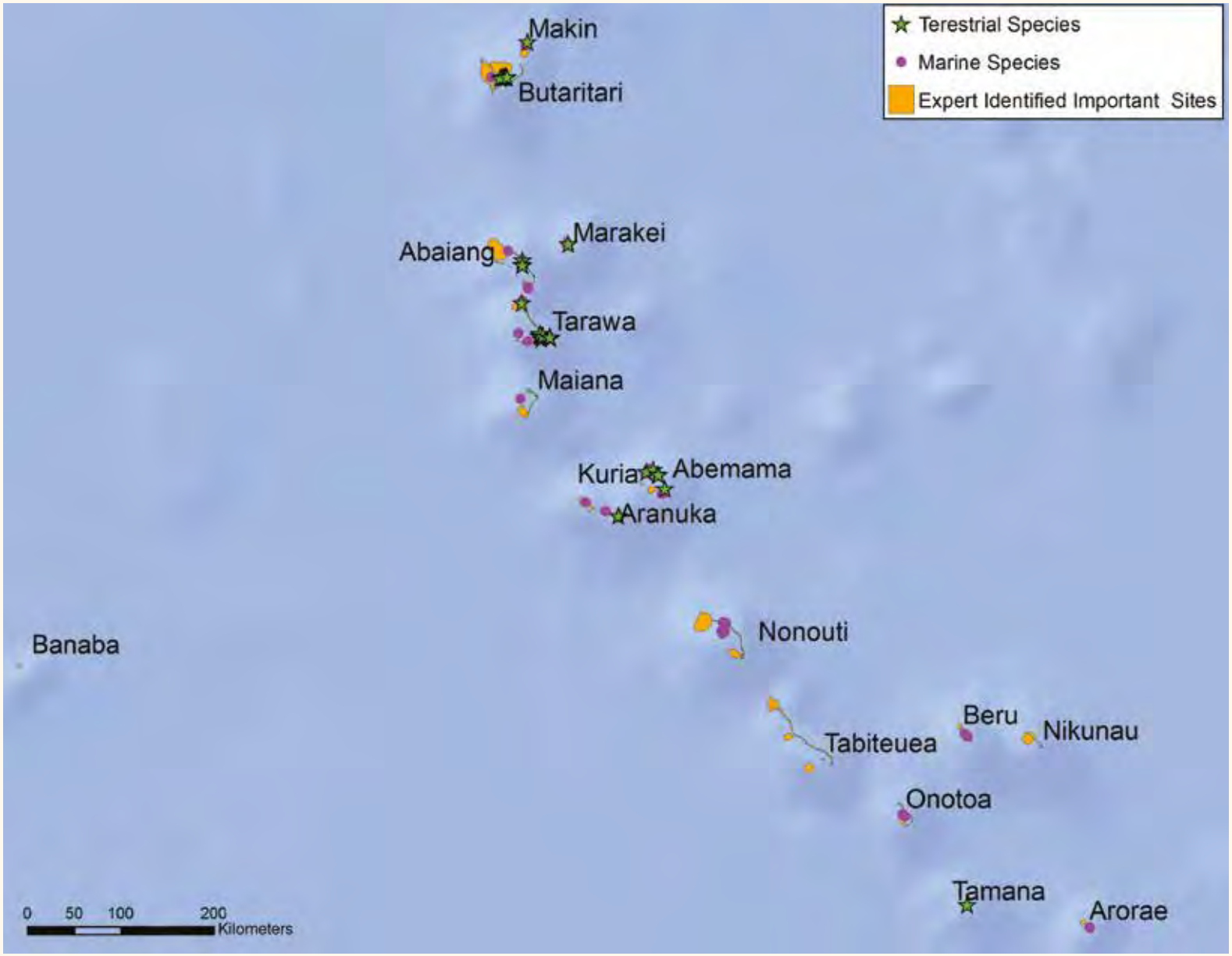
Giant clam

Photo Credit Paul Anderson

Humphead Wrasse (*Cheilinus undulatus*)

Photo Credit c) Wolcott Henry 2005/Marine Photobank

Map 3: Areas identified by Kiribati experts as areas of local concern



1. Abaiang Church. Like most parts of the Pacific, religion in Kiribati plays a major role in community life. *Photo © by Tony Whincup*
2. Traditionally constructed Kiribati house made from local resources. *Photo © by S. van Dijken*
3. Bwabwai (Ikaraoi/katutu) or Giant swamp taro. Valuable food crop in Kiribati. *Photo © by MELAD*
4. Sharks and other large pelagic fish species are a popular source of protein in Kiribati causing great pressure on these stocks, especially in the Gilbert Islands where the majority of the population live. *Photo © by Tony Whincup*

Phoenix Islands

Setting

The Phoenix Islands group is located 174°3'W to 170°4'W Longitude and 02°50'S to 04°40'S Latitude, sitting in the centre of the Republic of Kiribati between the Line Islands to the east and the Gilbert Islands to the west (refer to Map 1). The Phoenix Islands group consists of eight small atoll islands (Map 4). These include Abariringa, Birnie, Enderbury, Manra, McKean, Nikumaroro, Orona, and Rawaki.

Owing to their remoteness and a harsh climate, they are little disturbed by people. Only one of the islands (Kanton) is currently inhabited and that only by a small caretaker population (PIPA management plan 2010-2014).

Current Conservation Effort

Due to its remoteness and isolation, the Phoenix Islands may be one of the last atoll and reef island archipelagos on earth with unique and still unspoiled values, including pristine coral reefs and an abundance of fish and other marine wildlife, including globally important seabird populations. To protect these values, the Government of Kiribati declared the Phoenix Islands Protected Area (PIPA) in 2006 which subsequently became extended under formal designation with a total area of 408,250 km^2 (157,626 mi^2) with the adoption of the PIPA Regulations 2008. At this time PIPA was the world's largest marine protected area. Along with these regulations, the PIPA Trust Conservation Act of 2009 were enacted by Kiribati and are supported by its partners with the aim to ensure the sustainable financing needed for the conservation and management of PIPA is well established (PIPA management plan 2010-2014). For scale of PIPA please refer to Map 5.

Literature Review Summary

The Phoenix Islands literature review included the examination of a bibliography of 421 technical reports and academic articles on Kiribati that was compiled by Reefbase. Of these, 20 (4.75%) were found to be relevant to the Phoenix Islands. Additionally, a review of a bibliography list compiled by the New England Aquarium (NEAq) containing 55 mostly scientific references pertaining to the Phoenix Islands was completed.

Since 2003 there have been many scientific surveys conducted in the Phoenix group, and many references contained in the NEAq list reflected this effort, resulting in at least ten publications containing high quality point location data for effective KBA analysis. Furthermore, David Obura and Jim Maragos provided great assistance with point locality data for Red Listed coral species.

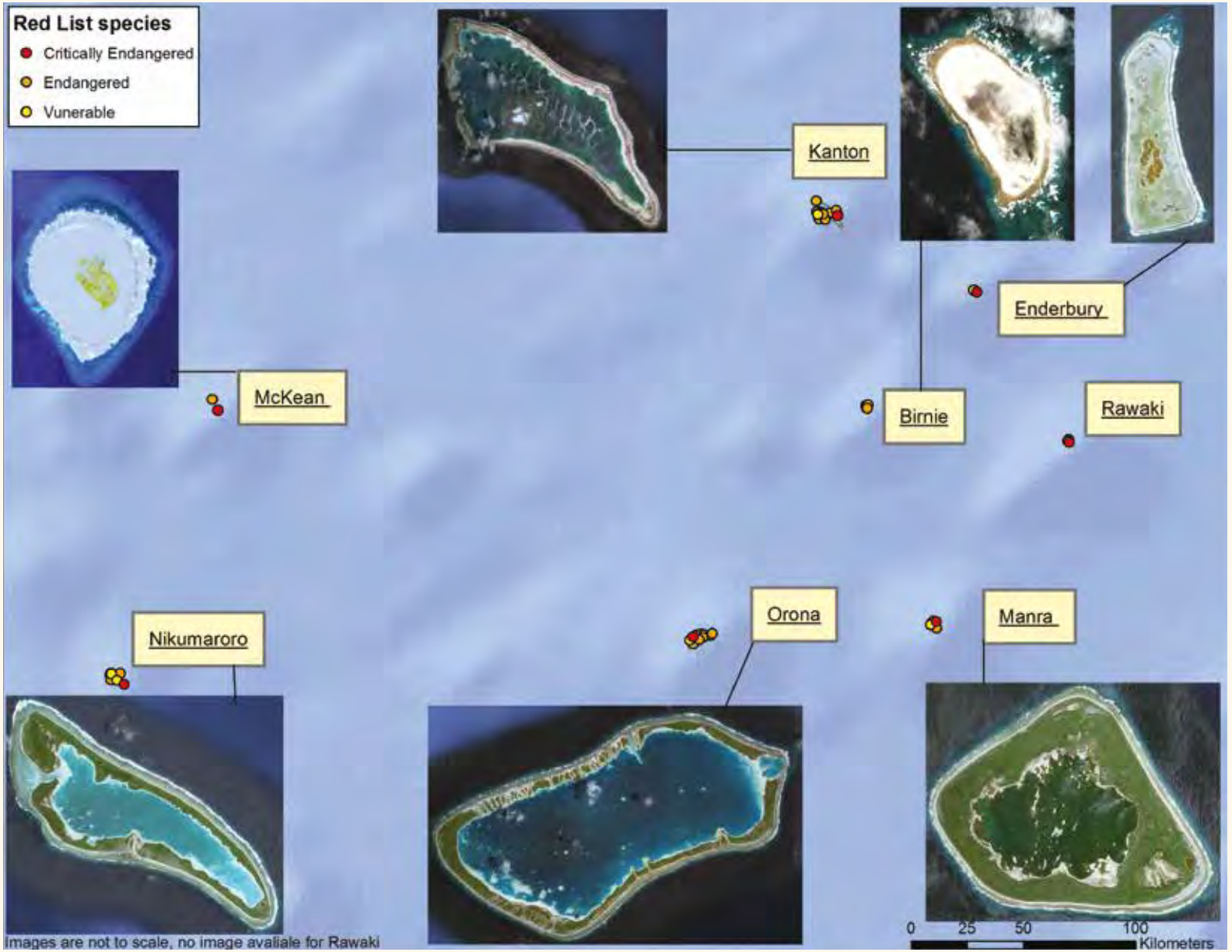
1: Phoenix petrel (*Pterodroma alba*) - currently breeding at PIPA only on Rawaki, this Endangered species might eventually spread to other rat-free islands. *Photo © by Ray Pierce*

2: White-throated Storm Petrel (*Nesofregetta fuliginosa*) *Photo © byRay Pierce*

Did you know?

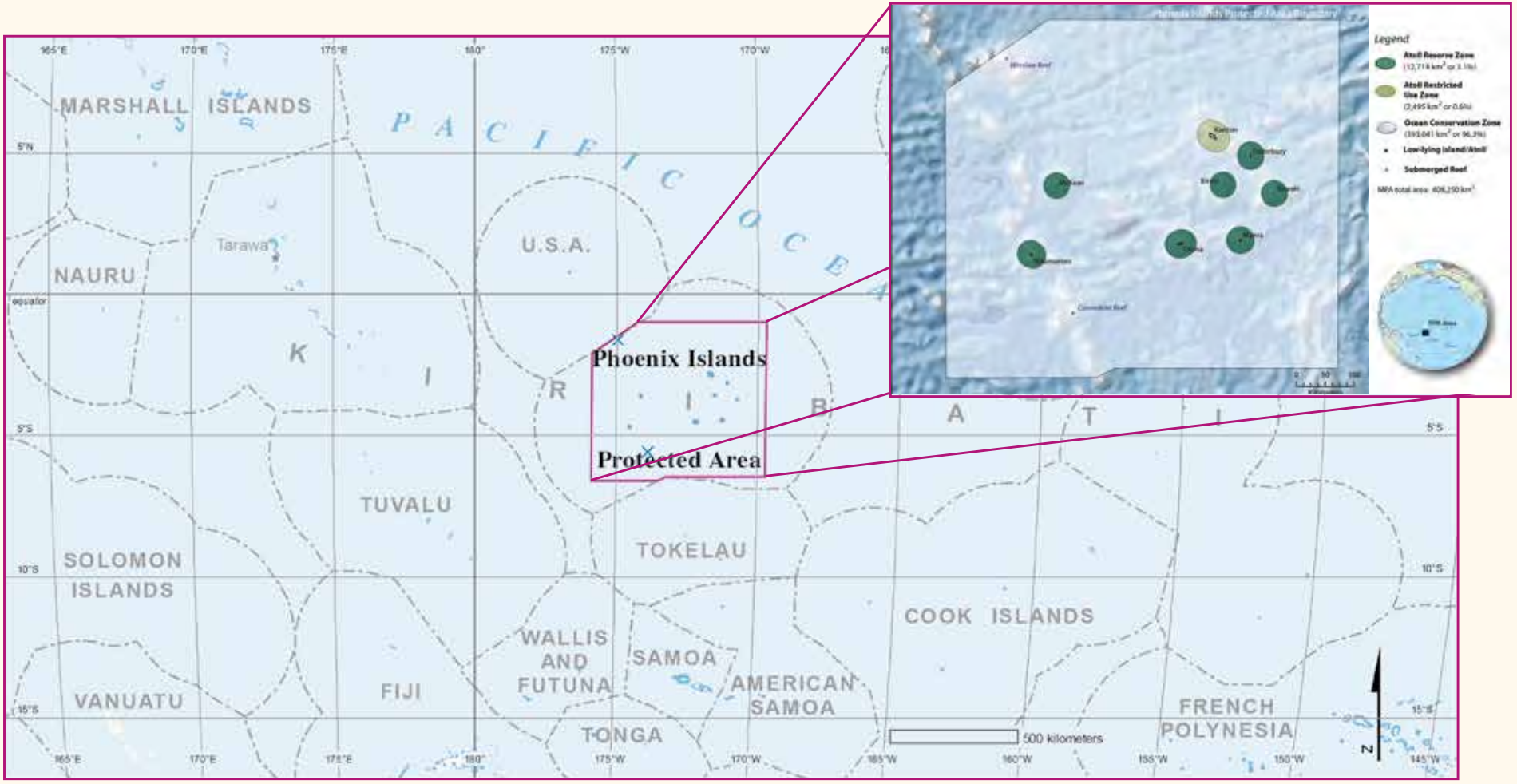
- Archaeological investigations have confirmed that Polynesians and Micronesians variously used the Phoenix Islands. However, all attempts at settlement appear to have been unsuccessful in the long term, likely due to limited freshwater resources and frequent droughts. The Phoenix Islands exemplifies the limit of Pacific peoples' migrations and attempted colonization.
- Nowadays, fewer than 30 people live in the Phoenix Islands.
- All Kiribati Islands in the Line and Phoenix Islands are owned by the Government of Kiribati.
- PIPA is the largest and deepest marine protected World Heritage Site and the second largest marine protected area in the world. Refer Map 5 for scale.
- A significant component of PIPA is deep sea and open ocean habitat. Little is known about the submerged reefs or 14 or more seamounts within PIPA's boundaries.
- Over 120 species of corals are found within the Phoenix waters
- The Phoenix waters provides habitat to more than 514 reef fish species.
- In 1937, on July 2, Aviator Amelia Earhart and navigator Fred Noonan disappeared over the Pacific in the vicinity of the Phoenix Islands. Nikumaroro is believed to be the resting place of Amelia and Fred.

Map 4: Phoenix Islands.



Note: pictures taken from Google Earth satellite images.

Map 5. Location of the Phoenix Islands Protected Area.



PIPA boundary
submerged reef
EEZ boundary
©2008 K.Koenig, CI Maps

scale: 1/23,000,000
projection: Sinusoidal
central meridian: 180°
datum: WGS84

acknowledgements:
New England Aquarium

data:
Conservation International - Pacific Islands
EEZs of the World, Flanders Marine Institute
VMap0, National Geospatial Intelligence Agency

KBA Results Based on IUCN Red List Criteria

As described earlier, the presence of either Critically Endangered (CR) or Endangered (EN) species automatically triggers the designation of a KBA. Map 4 and Table 4 illustrate that all Phoenix Islands meet this criterion. Furthermore, ten or more pairs of Vulnerable (VU) species also trigger a KBA. Because of the unique challenges of marine species surveys and the likelihood that more species are present than could be visually verified, the presence of twenty or more individuals is taken to indicate ten or more mating pairs. Considering this, four islands (Nikumaroro, Enderbury, Phoenix and Orona) rank higher as KBAs due to the number of VU species present and their recorded abundances.

Table 4: Number of KBA trigger species for the Phoenix Islands

RANK	SITE NAME	CR	EN	VU	IBA - A4 CATEGORY
1	Rawaki (Phoenix Island)	1	3	15	9
2	Orona Atoll (Hull Island	1	2	12	3
3	Abariranga (Kanton) Island	1	2	4	1
4	Nikumaroro (Gardner Island)	1	2	6	1
5	Enderbury Island	-	3	6	3
6	Manra	1	2	3	-
7	McKean Island	1	1	3	4
8	Birnie	-	2	-	-

Recommendations Based on Areas and Species of Local Expert Concern.

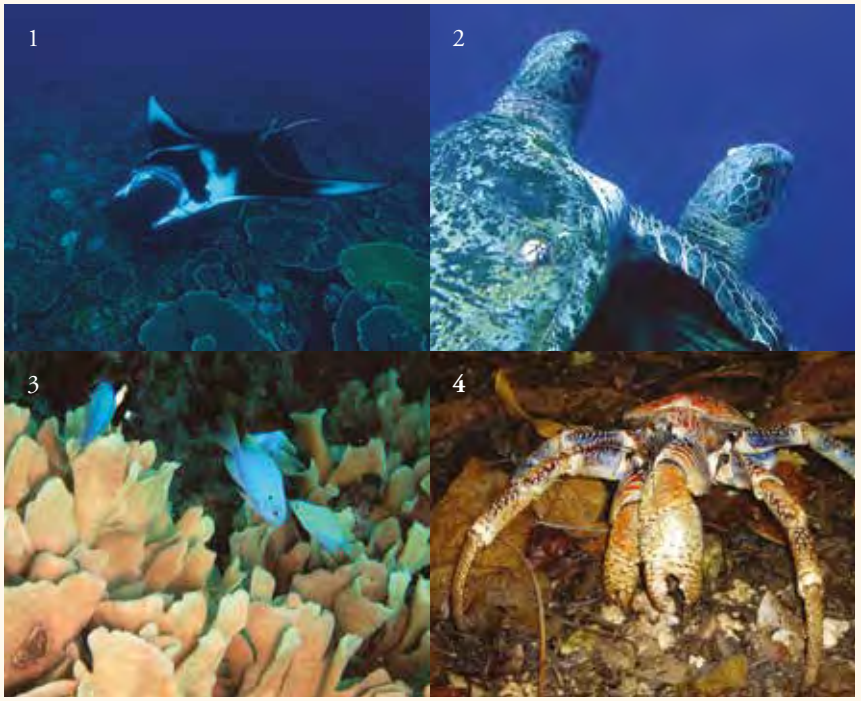
As outlined in the Gilbert Islands Results section, there are several reasons for including additional criteria in the designation of KBAs. As noted, significant biodiversity research gaps still exist, as well as gaps in the Red List itself. Due to the isolation of the Phoenix Islands and the sparse population present, data on species of local concern is scarce and not considered for the KBA analysis in the Phoenix Island context. Thus this section will focus recommendations based on areas of expert concern.

In comparison to the Gilbert and Line Islands, the Phoenix Islands have received more biodiversity-focused research. This effort has been driven by the creation of the PIPA. As a result of this targeted research in Phoenix Islands, all the islands in this group qualify as KBAs in this analysis. However, specific areas within the Phoenix Islands have been recommended by various marine science experts as areas of significance and great biodiversity value. Such recommendations help rank the Phoenix Islands KBAs to help evaluate where conservation effort should be concentrated.

Expert recommendations have suggested Orona, Nikumaroro, and Kanton as sites of special biodiversity interest. Table 5 illustrates the ten richest sites for fishes in the Phoenix Islands (reproduced from Allen and Bailey, 2011). This report indicates that Kanton alone has more sites with the total highest fish species count amongst all sites covered in the Phoenix group.

Nikumaroro further stands out as a site of significance, described as large enough to have a full range of atoll-associated habitats, and because it is uninhabited there is virtually no fishing pressure (Allen and Bailey 2011). The shark population is also healthy, compared to other places in the Phoenix Group where these animals have been recently decimated by foreign shark fin fishing (Obura and Stone 2003). Allen and Bailey (2011) described Nikumaroro as "the best location for sharks". Although shark species that have been identified in Phoenix waters are species listed as near threatened and thus do not trigger KBAs, the apparent damage to shark stocks by foreign fishing vessels underlines their fragility. Intense fishing over a relatively short period can cause considerable harm to shark populations due to the territoriality of reef sharks, their slow growth rate, and low fecundity (Allen and Bailey 2011). Therefore, reef shark species helps to rank current KBA islands.

Protection of the Vulnerable Bumphead Parrotfish (Bulbometopon muricatus) has been suggested at Orona Island, where large shoals of 200 or more individuals have been recorded (Allen and Bailey 2011). This species was also recorded at Kanton and Nikumaroro. The lagoon at Orona is "also notable for its population of juvenile Napoleon Wrasse (Cheilinus undulates, Endangered), with observations of as many as 20-25 per dive" (Allen and Bailey, 2011).



1 Manta ray over table corals.
Photo © by Cat Holloway.

2 Green turtles mating *(Chelonia mydas).*
Photo © by Jim Maragos.

3 Cactus coral *(Pavona Cactus).*
Photo © by Jim Maragos.

4 Coconut crab *(Birgus latro).*
Photo © by Rebecca Dominguez

Table 5: 10 richest fish sites in Phoenix Islands (Allen and Bailey, 2011)

SITE NO	LOCATION	TOTAL FISH SPP.
38	President Taylor, Kanton I.	166
67	Puff Magic, Birnie I.	161
68	Algae Corner, Orona I.	161
27	British Gas, Kanton I.	158
64	Lone Palm, Enderbury I.	156
31	Satellite Beach, Kanton I.	155
32	Weird Eddie, Kanton I.	155
34	President Taylor, Kanton I.	155
43	Satellite Beach, Kanton I.	155
21	Stillwater, Phoenix I.	154

Recommendations Based on Habitat Indicators

There are important reasons for considering habitat indicators when evaluating potential sites for KBAs. In comparison to the Gilberts and Line Islands, the Phoenix Islands group have received more detailed island-level habitat description. For example, Obura (2011) details coral reef structure and zonation for each of the Phoenix Island atolls. This level of detailed research is still required in the Gilbert and Line Islands.

As the level of research is not evenly distributed amongst all Kiribati Islands, comparing atolls is challenging. For this KBA analysis the habitat indicators provided below provide for evaluative consistency across Kiribati while also adding to our knowledge of each island's potential for biodiversity. As described in the earlier section, each island has varying levels of habitat availability ranging from simple fringing reefs to more complex lagoon systems. The following habitat indicators have been analysed for each atoll:

Geomorphic classes - Greater numbers of geomorphic classes present in one atoll complex suggest greater potential habitat diversity. Kanton and Orona have the greatest number of geomorphic classes in the Phoenix group.

Pinnacles - Pinnacles create vertical habitat structure in low wave energy environments and contribute to higher habitat diversity. Kanton and Orona lead this metric amongst the Phoenix Islands group.

Lagoon area metric - Because all islands have reef crest and slope habitats, the presence of a lagoon increases habitat diversity. Larger lagoons have the potential for more complex ecosystems and habitat complexes. Kanton and Orona lead this metric.

Passage area - Greater connectivity between the ocean and lagoon environments indicates better exchange of biota and nutrients. Kanton has a significantly higher number than the other Phoenix Islands.

Considering their geomorphic classes and the observations by experts of areas of special interest, it is not surprising that Kanton and Orona are islands of high KBA value. A summary of these criteria for the Phoenix Islands can be found in Figure B and Table C in Appendix A.

The metric system used above identifying Kanton and Orona as high value KBA sites is further supported in the literature, where Obura (2011) reports that lagoon reefs are well developed in Kanton and Orona, growing on relict reef structures and controlled by circulation of water in the lagoons. Obura (2011) outlines that the Phoenix Islands overall, considering the various characteristics of island size and dimensions, orientation and reef area, appear to cluster into three groups as follows:

1) the two largest islands with lagoons and extensive leeward reefs, Kanton and Orona (55% of all reefs);

2) three intermediate islands, Nikumaroro, Enderbury and Manra (31% of reefs); and

3) the three smallest islands, Birnie, Rawaki and McKean (14% of reefs).

Ranking

From all the available data that has been gathered for each island in this analysis, including number of IUCN Red Listed species, number of automatic KBA trigger species (species that are Red Listed as Critically Endangered or Endangered), and geomorphic values, a ranking calculation was created to prioritise KBA sites within the Phoenix Islands archipelago. As described earlier, a formula was used that took each category above and standardised values amongst each Phoenix Island to obtain a final ranking percentage. Heavy weight was given to number and presence of automatic KBA trigger species (45%), followed by number of IUCN Red Listed threatened species (35%), followed by geomorphic score for each island (20%). Figure 2 illustrates the results of this analysis for the Phoenix Islands.

Although all islands in the Phoenix Island group automatically qualify as KBA according to the methodology used, Orona (Hull), Rawaki (Phoenix) and Abariranga (Kanton) have higher KBA status ranking due to a combination of Red Listed species, habitat types and areas of expert concern.

Although the remaining islands appear lower on the ranking percentage score, this result may be due to the relatively low number of automatic KBA trigger species (number of Endangered and Critically Endangered species). This is not to say that these trigger species are not found, but rather that they have not been formally recorded.

Figure 2: Phoenix Islands KBA ranking.

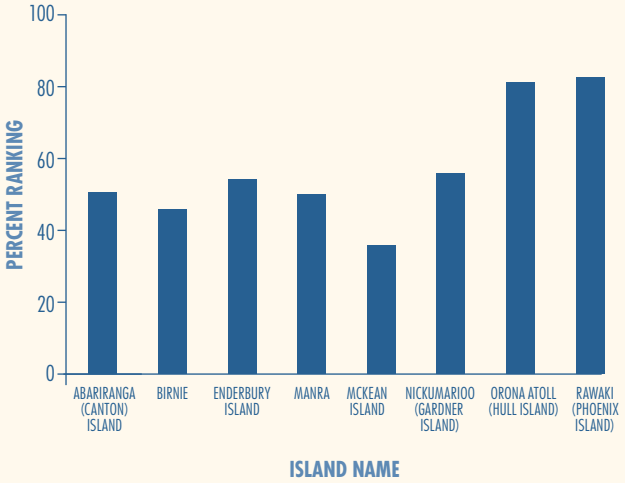


Table 6: Profile of Key Biodiversity Areas in Phoenix Islands

SITE KBA PRIORITY NUMBER	SITE NAME	APPROXIMATE AREA (KM^2)	CURRENT PROTECTION STATUS	KBA TRIGGER SPECIES IN SITE	THREATS
1	Rawaki (Phoenix Island)	2.97	PIPA	Hawksbill Turtle (*Eretmochelys imbricata*), Green Turtle (*Chelonia mydas*), Humphead Wrasse (*Cheilinus undulates*), Phoenix Petrel (*Pterodroma alba*), White-throated Storm Petrel (*Nesofregetta fuliginosa*), Christmas Shearwater (*Puffinus nativitatis*), Masked Booby (*Sula dactylatra*), Lesser Frigatebird (*Fregata ariel*), Grey-backed Tern (*Sterna lunata*), Black Noddy (*Anous Minutus*) Coral species: *Acropora globiceps, Acropora retusa, Pavona cactus, Pavona danai, Pavona decussate, Turbinaria stellulata, Leptoria irregularis*, and *Psammocora stellate*	Illegal fishing Invasive species pose a threat. (Gupta 2007).
2	Orona Atoll (Hull Island)	48.41	PIPA	Hawksbill Turtle (*Eretmochelys imbricata*), Green Turtle (*Chelonia mydas*), Humphead Wrasse (*Cheilinus undulates*), Bumphead Parrotfish (*Bulbometopon muricatum*), Polkadot Cod (*Plectropomus areolatus*), Lesser Frigatebird (*Fregata. ariel*), Sooty Tern (*Sterna. Fuscata*), Grey-backed Tern (*Sterna lunata*) Coral species: *Acropora paniculata, Acropora acuminate, Leptoseris incrustans Leptoria irregularis Montipora caliculata, Montipora lobulata, Pavona danai, Pocillopora elegans*, and *Pavona venosa*	Illegal fishing Invasive species pose a threat. (Gupta 2007).
3	Abariranga (Kanton Island)	78.31	PIPA	Hawksbill Turtle (*Eretmochelys imbricata*), Humphead Wrasse (*Cheilinus undulates*), Bumphead Parrotfish (*Bulbometopon muricatum*), Polkadot Cod (*Plectropomus areolatus*), Giant Grouper (*Epinephelus lanceolatus*), Phoenix Petrel (*Pterodroma alba*), Grey-backed Tern (*Sterna lunata*) Coral species: *Acropora retusa, Pavona cactus, Pavona danai, Pavona decussata, Turbinaria stellulata, Leptoria irregularis*, and *Psammocora stellata*	Illegal fishing Invasive species pose a threat. (Gupta 2007).
4	Nikumaroro (Gardner Island)	19.08	PIPA	Hawksbill Turtle (*Eretmochelys imbricata*), Green Turtle (*Chelonia mydas*), Blacksaddled Coral Grouper (*Plectropomus laevis*), Humphead Wrasse (*Cheilinus undulates*), Red-tailed Tropicbird (*Phaethon rubricauda*), Brown Booby (*Sula leucogaster*), Coral species: *Pavona venosa, Psammocora stellate*, and *Turbinaria reniformis*	Illegal fishing. Invasive species pose a threat. (Gupta 2007).
5	Enderbury Island	11.23	PIPA	Green Turtle (*Chelonia mydas*), Humphead Wrasse (*Cheilinus undulates*), Phoenix Petrel (*Pterodroma alba*), Red-tailed Tropicbird (*Phaethon rubricauda*), Masked Booby (*Sula dactylatra*), Lesser Frigatebird (*Fregata. ariel*), Sooty Tern (*Sterna fuscata*), Grey-backed Tern (*Sterna lunata*) Coral species: *Leptoseris incrustans*	Illegal fishing. Invasive species pose a threat. Feral cats have been observed causing bird mortality. Rats are also present (Gupta 2007).
6	Manra	14.05	PIPA	Hawksbill Turtle (*Eretmochelys imbricata*), Green Turtle (*Chelonia mydas*), Humphead Wrasse (*Cheilinus undulates*) Coral species: *Leptoseris incrustans, Psammocora stellata*, and *Turbinaria reniformis*	Illegal fishing.
7	McKean Island	2.31	PIPA	Hawksbill Turtle (*Eretmochelys imbricata*), Green Turtle (*Chelonia mydas*), White-throated Storm Petrel (*Nesofregetta fuliginosa*), Lesser Frigatebird (*Fregata. ariel*), Sooty Terns (*Sterna fuscata*)	Invasive species pose a threat. (Gupta 2007).
8	Birnie	3.13	PIPA	Green Turtle (*Chelonia mydas*), Humphead Wrasse (*Cheilinus undulates*) Coral species: *Acropora acuminata, Acropora microclados, Pocillopora meandrina* (*elegans*)	Illegal fishing.

Summary and Recommendations

All Phoenix Islands are identified as KBAs. Table 6 gives a summary of recommended high value KBAs for each set of criteria and the species that occur there. In all cases the recommendations of experts and habitat considerations strengthen the suggestions made using the current IUCN Red Listed species KBA criteria alone.

Kiribati has long recognised the importance of this isolated special archipelago and its biodiversity values. All the islands are protected under the Phoenix Island Protected Area, and are thus already under an implemented management plan for full protection.

The KBA process outlined here has, however, added value in identifying which islands within the group have "higher" biodiversity values and have allowed the islands to be ranked with these values in mind. This ranking is important as it can help focus conservation efforts given the vast area and limited resources of the Government of Kiribati.

1 Bumphead parrotfish (*Bolbometopon muricatum*). Large schools of these fish occur throughout PIPA. *Photo © by David Obura*

2 Giant clams (*Tridacna maxima*) are abundant in PIPA. These clams are prized and over harvested in most areas of the pacific and it is very rare to see so many together. *Photo by Randi Rotjan.*

Setting

The Line Island group consists of eight small atoll islands. These are Teraina, Tabuaeran, Kiritimati, Malden, Starbuck, Vostok, Millennium, and Flint. These islands' total land area is 496.5 km^2, extending over a north-south distance of 2,100 km, located at a distance of between 3,280 and 4,210 km east of Tarawa and some 800 km south of Hawaii (Map 6). This group includes the largest island in Kiribati, Kiritimati, with an area of 388.4 km^2.

Only three of the islands are inhabited, Teraina, Tabuaeran, and Kiritimati (which has been described as the second capital of Kiribati, holding a population of over 3,500 people (Kiribati report to CBD).

Current Conservation Effort

The three proposed KBAs of Malden, Starbuck, and Vostok in the Line Islands have been Wildlife Sanctuaries since 1975 (Malden and Starbuck), and 1979 (Vostok) (Perry, 1980). Caroline (Millennium) Island has also recently been considered as a World Heritage Site. Kiritimati was first proclaimed a Wildlife Sanctuary in 1960, and the Cook, Motu Tabu, and Motu Upua islets on Kiritimati were declared reserves with restricted access. The additional areas of Northwest Point and Ngaon te Taake were later added as reserves (Garnett, 1981). The areas of Southeast Peninsula and Isles Lagoon were also named Key Wildlife Areas (Perry, 1980). Furthermore, the following areas on Kiritimati are closed areas: Dojin, Tanguoua, Koil, Toyota, and Mouakena. All sea, migrant, and endemic land birds in these areas are protected under the 1975 Wildlife Conservation Ordinance (Kepler et. al., 1994). Refer to Appendix A, Map B for illustration of conservation effort in the Line Islands.

Literature Review Summary

The Line Islands literature review used the same criteria and literature set as the Gilbert and Phoenix Islands reviews. In comparison to the Phoenix and Gilbert island groups, the Line Islands have had limited biodiversity research, with the exception of Kiritimati Island which has had significantly more research attention in comparison to its island neighbours within the Line Islands. Much of the relevant information obtained for the Line Islands were obtained from personal communications with scientific and expedition experts that have had extensive experience in the archipelago and who provided valuable point location data on IUCN Red Listed species. Much of this data has yet to be formally published, and have been used in this report for the first time. Gratitude is expressed to David Obura, Jim Maragos, Vince Ker, Angela Kay Kepler, and Alan Friedlander.

KBA Results Based on IUCN Red List Criteria

As stated above, the presence of either Critically Endangered (CR) or Endangered (EN) species automatically triggers a KBA. Map 6 shows that seven islands (Teraina, Tabuaeran, Kiritimati, Malden, Vostok, Caroline, and Flint) meet this criterion, although none of the islands in this group had enough observed mating pairs of Vulnerable (VU) species to trigger a KBA. Based on KBA criteria alone, these seven islands are recommended. Within this list, both Kiritimati and Caroline stand out as having the most EN species and IBA A4 category ("congregation") species.

Table 7: Number of KBA trigger species for the Line Islands

RANK	SITE NAME	CR	EN	VU	IBA - A4 CATEGORY
1	Kiritimati	-	2	11	13
2	Tabuaeran (Fanning)	-	1	11	2
3	Caroline (Millennium)	-	2	7	8
4	Teraina (Washington)	-	1	6	1
5	Malden	-	1	3	5
6	Flint	-	1	4	-
7	Vostok	-	1	4	2
N.A	Starbuck	-	-	4	1

Recommendations Based on Species and Areas of Local Expert Concern.

Little available information exists about species of local concern in the inhabited Line Islands. Although there is a significant amount of raw data in the Kiribati Ministry of Culture, not all of it has been analysed and made available. However, as detailed in Appendix B in Areas of Local Biocultural Concern, there are concerns in Kiritimati about milkfish and frigate birds, the populations of which have been in decline since the 1970s. There is also concern that human population growth is responsible for these declines as well as other impacts, such as a drop in the number of coconut trees used in copra production. The growing population in the Line Islands reflects the government resettlement scheme moving people here from the Gilbert Island Group, more specifically to Fanning (Tabuaeran) and Washington (Teraina) (Akoako, 2004).

Recommendations Based on Habitat Indicators

As indicated earlier the level of biodiversity research is not evenly distributed amongst all islands in Kiribati and therefore comparing atolls is challenging. The habitat indicators provided below provide evaluative consistency across the archipelago while also adding to our knowledge of each island's potential for biodiversity.

The following habitat indicators have been analysed for each atoll:

Geomorphic classes: Greater numbers of geomorphic classes present in one atoll complex suggest greater potential habitat diversity. Tabuaeran and Kiritimati have the greatest number of geomorphic classes and thus greater potential for high biodiversity.

Pinnacles: Pinnacles create vertical habitat structure in low wave energy environments and contribute to higher habitat diversity. Tabuaeran leads this metric amongst the Line Islands group, followed by Caroline. No other islands in this group include significant pinnacles.

Lagoon area metric: Because all islands have reef crest and slope habitats, the presence of a lagoon increases habitat diversity. Larger

Healthy Reef habitat as seen here is common in the Phoenix and Line Islands.
The pink coloration is crustose coralline algae, which promotes new coral growth.
Photo © by Randi Rotjan.

Map 6. Line Islands. Identified KBAs are highlighted in yellow.

Did you know?

- Kiritimati Island within the Line Islands is the largest atoll in the world by land surface. It forms over 70% of the total land area in Kiribati.
- Kiritimati was used by the British to test nuclear weapons in the 1950s and 1960s.
- High quality salt mining occurs on Kiritimati and is only exported to Japan. About 70-100 tonnes of this "solar salt" are exported annually.
- The whole of Kiritimati Island is a classified as a wildlife sanctuary under the Wildlife Ordinance of 1977.
- There is only one endemic vertebrate species, the Line Islands Reeds Warbler, also known as the Christmas Island Warbler or Kokikokiko (Acrocephalus aequinoctialis).
- Millennium atoll was the first island in world to welcome in the new Millennium 2000, which is why its name was changed from Caroline.
- To get to the Line Islands from Tarawa you must travel through either Hawaii or Fiji to get there.
- Kiritimati is a world class fly fishing destination and also attracts tourists for its birdlife and surf.

lagoons have the potential for more complex ecosystems and habitat complexes. Kiritimati strongly leads this metric followed by a much smaller lagoon area on Tabuaeran.

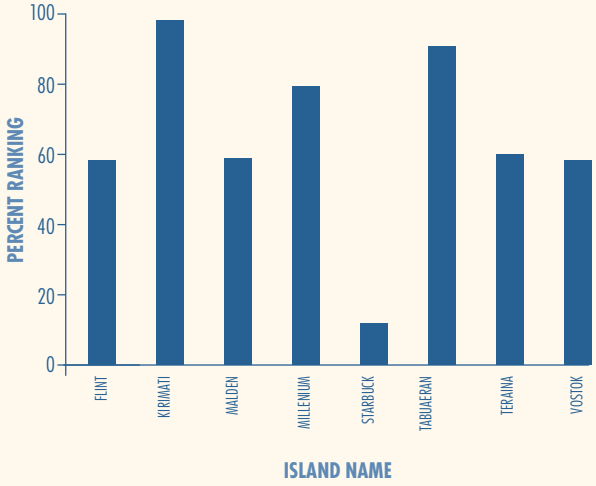
Passage area: Greater connectivity between the ocean and lagoon environments indicates better exchange of biota and nutrients. Tabuaeran is the only island in the Line group that has a significant passage area.

Tabuaeran and Kiritimati are clearly the most significant islands in terms of habitat indicators. Kiritimati has a strong presence of geomorphic features, relative to other Line Islands. These are lagoon and brackish lagoon areas. Tabuaeran includes three geomorphic classes: pinnacles, passages, and lagoon area. Therefore, these two islands rank most highly in terms of geomorphic features as well as overall habitat indicators. Figure C in Appendix A illustrates the geomorphic classes for each island. Table C in Appendix A outlines island physical properties as well as geomorphic data. Considering these geomorphic classes and data, it is not surprising that Kiritimati and Tabuaeran are islands of high KBA value.

Ranking

From all the available data that has been gathered for each island in this analysis, including number of IUCN Red Listed species, number of automatic KBA trigger species, and geomorphic values, a ranking calculation was created. As described on p.15 a formula was used that took each category above and standardised values amongst each Kiribati island to obtain a final ranking percentage. Figure 4 illustrates the results of this ranking analysis.

Figure 4: Line Islands KBA ranking.



Summary and Recommendations

All islands in the Line Island group, with the exception of Starbuck, are identified as KBAs. Table 7 and 8 gives a summary of recommended high value KBAs for each set of criteria. Furthermore, the Line Islands can be categorised generally into three ranking groups. Kiritimati, Tabuaeran and Millennium received the highest ranking, mainly due to the high number of Endangered and Vulnerable species present on these islands. These islands also have high geomorphic scores and meet criteria for both KBA and IBA sites.

The second ranking group consists of Flint, Malden, Teraina and Vostok. With the exception of Flint these islands also meet the criteria for both KBA and IBAs, but are generally smaller atolls than the first group, with lower geomorphic scores. The third and lowest ranked group consists of an individual island, Starbuck. This island is an IBA but does not meet the criteria as a KBA, if IBA status is excluded. Those that meet both KBA and IBA criteria independently have received the highest score and thus priority. However, Starbuck is already a wild life sanctuary and deserves special mention here.

The KBA process has identified which Line Islands have "higher" biodiversity values and ranked them accordingly. This ranking can help focus conservation efforts given the vast area, and the limited resources of the Government of Kiribati

1 Great Frigatebird. *Photo © by Ray Pierce*
2 White Tern. *Photo © by Ray Pierce*
3 Blue Noddy. *Photo © by Ray Pierce*

Table 8: Profile of Key Biodiversity Areas in Line Islands

SITE KBA PRIORITY NUMBER	SITE NAME	APPROXIMATE AREA (KM^2)	CURRENT PROTECTION STATUS	KBA TRIGGER SPECIES IN SITE	THREATS
1	Kiritimati	709.47	Whole Island is Wildlife sanctuary. Further protection status is given to the smaller islands of: Cook Island; Motu Tabu; Moto Upua Ngaontetaake, Dojin Tanguoua, Koil Toyota, Mouakena	Christmas Island Warbler (*Acrocephalus aequinoctialis*), Christmas Shearwater (*Puffinus nativitatis*), Wedge-tailed Shearwater (*P. pacificus*), Phoenix Petrel (*Pterodroma alba*), White-throated Storm Petrel (*Nesofregetta fuliginosa*), Red-tailed Tropicbird (*Phaethon rubricauda*) , Masked Booby (*Sula dactylatra*), Red-footed Booby (*S. sula*), Great Frigatebird (*Fregata minor*), Lesser Frigatebirds (*F. ariel*), Sooty Tern (*Sterna. fuscata*), Black Noddy (*Anous. minutus*) , Blue Noddy (*Procelsterna cerulean*), White Tern (*Gygis alba*), Humphead wrasse (*Cheilinus undulates*) Coral species: *Acropora globiceps, Acropora retusa, Acropora spicifera, Astreopora cucullata, Barabattoia laddi, Montipora caliculata, Pachyseris rugosa, Pavona venosa, Pocillopora meandrina (elegans), Turbinaria reniformis, and Turbinaria stellulata,*	The island is inhabited with several thousand people and is expected to develop more. Human presence has been associated with decline of species, particularly through the introduction of alien species, including rats, cats, and dogs, and through clearing of habitat and fires. Parts of the atoll have been set aside as restricted Reserves or Key Wildlife Areas. (Gupta 2007).
2	Tabuaeran (Fanning)	170.57		Kuhl's Lorikeet (Vini kuhlii), Red-footed Booby (S. sula), White Tern (Gygis alba), Humphead wrasse (Cheilinus undulates) Coral species: *Acropora acuminata, Acropora echinata* (*procumbens*), *Acropora paniculata, Acropora retusa, Acropora vaughani, Alveopora verrilliana, Montipora caliculata, Montipora patula, Pavona decussata,* and *Pocillopora meandrina* (*elegans*)	The island is inhabited. The ship rat is present. (Gupta 2007).
3	Caroline (Millennium)	30.34	Proposed whole island protection.	Bristle-thighed Curlew (*Numenius tahitiensis*), Red-tailed Tropicbird (*Phaethon rubricauda*), Red-footed Booby (*Sula sula*), Great Frigatebird (*Fregata minor*), Lesser Frigatebird (*F. ariel*), Sooty Tern (*Sterna. fuscata*), Black Noddy (*Anous minutus*) , Blue Noddy (*Procelsterna cerulean*), White Tern (*Gygis alba*), Green turtle (*Chelonia mydas*), Giant clam (*Tridacna gigas*), Humphead wrasse (*Cheilinus undulates*)	Coral species, Leptoseris incrustans, Montipora caliculata, Montipora lobulata, Pavona venosa, Pocillopora meandrina (elegans), and Psammocora stellata; The island is inhabited and signs of human impact are visible. Rats are present, however, the vegetation is relatively undisturbed, with a high rate of native vegetation present. The island has recently been proposed as a World Heritage Site (Gupta 2007).
4	Teraina (Washington)	32.69		Kuhl's Lorikeet (*Vini kuhlii*), Phoenix Petrel (*Pterodroma alba*), White-throated Storm Petrel (*Nesofregetta fuliginosa*), Christmas Island Warbler (*Acrocephalus aequinoctialis*), White Tern (*Gygis alba*) Coral species: *Astreopora cucullata, Montipora caliculata, Montipora patula, Pavona venosa, Pocillopora meandrina* (*elegans*), and *Turbinaria reniformis,*	Rats, cats, and ungulates are eradication targets for the inhabited island. Rats are present but rare. (Gupta 2007).
5	Malden	46.97	Proposed bird sanctuary: Whole Island wild life sanctuary and strict nature reserve (closed area).	Masked Booby (*Sula dactylatra*),, Brown Booby (*S. leucogaster*), Red-footed Booby (*S. sula*), Great Frigatebird (*Fregata minor*), Lesser Frigatebirds (*F. ariel*), Green turtle (*Chelonia mydas*). Coral species: *Acropora microclados, Montipora caliculata, Pavona venosa,* and *Pocillopora meandrina* (*elegans*).	The uninhabited island has Reserve status. It is a wildlife sanctuary under IUCN category Ia* since 1975 (Akoako, 2004).
6	Flint	6.01		Green Turtle (*Chelonia mydas*) Coral species: *Montipora caliculata, Pocillopora meandrina* (*elegans*) and *Psammocora stellate.*	
7	Vostok	1.49	Island is wild life sanctuary and has habitat/species management area.	Red-footed Booby (*S. sula*), Great Frigatebird (*Fregata minor*), Humphead wrasse (*Cheilinus undulates*). Coral species: *Acropora retusa, Montipora caliculata, Pocillopora meandrina* (*elegans*), and *Psammocora stellata,*	This may be the one island where alien species pose little to no problem (Gupta 2007). Vostok is a wildlife sanctuary under IUCN category IV* since 1979. (Akoako, 2004).
N.A	Starbuck	38.24	Proposed bird sanctuary: whole island Wild life sanctuary and strict nature reserve (closed area).	Sooty Tern (*Sterna. fuscata*). Coral species: *Acropora microclados, Montipora caliculata, Pocillopora meandrina* (*elegans*), and *Psammocora stellata,*	Cats may be present on the island. (Gupta 2007). The uninhabited island has Reserve status. It is a wildlife sanctuary under IUCN category Ia* since 1975 (Akoako 2004). Cats may be present on the island. (Gupta 2007).

*For IUCN protection categories,r please refer to Table D in Appendix A.

Main Findings and Recommendations.

Twenty-two KBAs have been identified in Kiribati, eight of which are currently managed as PAs within the World Heritage site the Phoenix Island Protected Area. In the Line Islands, Malden, Starbuck and Vostok have protection status of mixed management and Kiritimati Island has a number of mixed areas of current protection. Millennium Island is also a proposed world heritage site. The current levels of effective conservation management on these Line Islands are unknown. The remaining Kiribati islands, including all of the Gilbert Islands have no ongoing active conservation management. Thirteen of the 21 sites have recently been identified as Important Bird Areas (IBAs) by BirdLife International and Conservation International (CI) (Gupta 2007).

Through the process of identifying KBAs, the detailed assessment of gaps in our knowledge of terrestrial and marine biodiversity has identified a number of taxonomic, thematic and geographic knowledge gaps within each island archipelago. The taxonomic knowledge gaps include threatened plants, seabirds, corals and current population estimates of most marine biodiversity in general. The main thematic knowledge gap is our knowledge of the biology and ecology of native species. We have a poor understanding of the current population, distribution, habitat, threats and feeding and breeding biology of most native species. This scant knowledge makes it difficult to adequately define effective conservation areas and other strategies that will allow threatened species to survive into the future. The main spatial knowledge gaps include most of the Gilbert Islands group and parts of the Line Islands. Each KBA identified here has its own particular challenges and opportunities.

Gilbert Islands:

Major taxonomic, thematic and geographic spatial knowledge gaps exist in the Gilbert Islands. Due the paucity in directed biodiversity research, species knowledge and identification is low here. This should be of high priority given the high population levels in the Gilbert Island group and human reliance on the islands' biodiversity resources. If given significant effort, or at least on par with the directed research in the Phoenix Islands, more realistic trends and data may emerge. For instance, it is widely recognised in scientific literature that there is diminishing habitat and species diversity when moving from west to east across the Pacific, with both terrestrial and marine biodiversity generally being highest in the western regions of the Pacific (Mittermeier et al. 1999, Maragos 1996). However, in this KBA analysis the Gilbert Island archipelago, which is a central Pacific arc but the furthest west of all Kiribati archipelagos, shows limited species biodiversity in comparison to the further eastern Kiribati archipelagos of Phoenix and Line Islands. Furthermore, the geomorphic score and analysis done in this study shows that most of the Gilbert Island KBAs have higher habitat diversity than the Phoenix and Line Islands, indicating further potential for higher biodiversity.

The uncharacteristic trend observed is most likely due to the limited biological scientific studies conducted within the Gilbert Islands group but also potentially (and more importantly) due to the impacts of higher human pressure on this archipelago. If given the same amount of targeted biological research as conducted in the Line and Phoenix Islands, a more comprehensive assessment of potential KBAs and impacts on biodiversity from human pressure in the Gilbert Islands can be made. A key finding of this analysis has shown that there are significant data gaps and Gilbert Islands illustrates that targeted biological data is important in identifying key biodiversity areas and prioritising conservation effort and planning.

In the Gilbert Islands each island has a single island community and Island Council which can be engaged to actively conserve their resources. This is a strength that can be fostered by building awareness and local ownership amongst the community, and will help communities to engage in managing their resources in a sustainable and conserving manner. Quick action can be taken on education, outreach, and data collection as well as engaging in the normal village consultation process. For the sake of efficiency, current biodiversity management plans can be integrated with existing island programs and initiatives including waste and development.

Phoenix Islands:

In the Phoenix group, all islands are identified as KBAs and have current protection and management under PIPA. The coral reefs and habitats of the Phoenix Islands are of national, regional and global importance. They provide a unique opportunity in the Pacific for conservation of biodiversity and a significant baseline database which is lacking for most of the atolls of the Gilbert group and other densely populated islands of Kiribati (Akoako 2004). Maintaining these values is a challenge due to their isolation and enforcement of management plan regulations. However, enforcement and ongoing diligent management of these islands should be a top priority for Kiribati and its partners, as these are truly unique "jewels in the crown" of protected areas within the entire region.

Line Islands

The Line Islands KBAs identified provide some KBA sites that would allow for easy expansion of the PA network. Some of the islands such as Malden, Vostok and Starbuck present areas that have already been given protection status or have been proposed for protection. It is recommended that priority be given to the creation of up-to-date, effective management plans of these islands to capitalize on current protection status areas that can be added to the PA network. Inhabited islands such as Kiritimati, Tabuaeran and Caroline pose challenges and opportunities as KBAs. Due to the current population level and large size of Kiritimati Island, smaller mixed managed areas on this island are sensible, with some being effectively managed currently. However there are opportunities to strengthen currently managed high biodiversity areas as well as identify and create new areas within Kiritimati through community involvement, consultation and awareness raising. Consultation and education with each inhabited KBA island can create strong ownership and therefore more effective management and enforcement of regulations. In addition, inhabited islands in this archipelago allow for more cost-effective surveillance and management of other KBA Line Islands that are uninhabited. It is recommended that the total area of protection and management for uninhabited KBA islands be increased from 100m of shore (which was the scope and assessment area of this study) to 12nm offshore to encompass each islands near coastal and semi-pelagic environment.

Healthy Coral reef as seen in the Phoenix Islands.
Photo © by Randi Rotjan

Did you know?

- Did you know that in Kiribati over 80% of the protein consumed from local sources comes from the sea?
- Did you know that coral reefs are the largest living structures on the planet?
- Coral reefs form natural barriers that protect nearby shorelines from the eroding forces of the sea, thereby protecting coastal dwellings, agricultural land and beaches. So if you are worried about climate change reefs are your first line of defense.
- Also resources like coral reefs and mangroves protect the land by breaking up big waves and reducing wave energy such as that from tsunamis and storm surges.
- Although coral reefs cover less than 1% of the Earth's surface, they are home to 25% of all marine fish species.

Key findings of this project:

- The total area of KBAs in Kiribati is about 4000 km^2 (74% of the land and inshore reef area of Kiribati, not including EEZ).
- The highest priority sites are Abaiang, Rawaki and Kiritimati which account for 21% of the total KBA area and 10%, 1.7% and 68% of each archipelago respectively.
- The area of KBAs with some form of existing protection is approximately 228 km^2, or 5.7% of the area of all KBAs. This excludes Kiritimati which has separate areas of specific protection.
- With the inclusion of PIPA, Kiribati KBAs protect approximately 12% of Kiribati, exceeding the CBD 10% marine target.
- KBAs capture key habitat for 15 of the 24 Kiribati vertebrate species currently classified as threatened on the IUCN Red List and at least 30 of the 66 coral species listed. The other 45 species may occur in the KBA network but the datasets are currently insufficient to verify their presence or absence.
- KBAs include coastal and all near shore habitat types in Kiribati.
- The IUCN Red List is highly under-representative of the true number of threatened species in Kiribati.
- The key gaps in our knowledge of biodiversity include our ecological knowledge of native species in general but especially of threatened corals, invertebrates, and fish.

General Recommendations:

- Kiribati can act now to protect native marine biodiversity, as key areas and priorities for conservation are known.
- Kiribati must raise awareness at all levels of society about Kiribati's threatened species, the sites where they are found and what must be done to conserve them.
- More integrated marine surveys are needed, including targeting threatened taxa, to provide an improved basis to monitor the effectiveness of existing managed sites and to improve the knowledge base for targeting new sites. Additional surveys also needto be undertaken in the KBAs that have been identified, as more rare species are likely to exist in these areas. This should be undertaken as part of protected area management.
- Some threatened species need special protection in the entire country, not just in key sites (e.g. migratory species such as the White-throated Storm-petrel, Hawksbill and Green turtles, long-lived fish, and clams).
- Existing fisheries and conservation regulations and laws should be strengthened, promoted and enforced. Furthermore, integrating biodiversity plans with other existing island programs and initiatives, including waste and development plans, can help streamline effective implementation and efficient use of resources. Conducting education and awareness workshops would help facilitate this process. This can be done through island consultations and by potentially establishing a biodiversity and conservation curriculum in schools where the younger generation are shown the importance of sustainable practices and conservation values that are important to their own sustainable development. This could also be integrated into the existing culture curriculum.
- Resource use and conservation are not mutually exclusive and can both be enhanced through good management of resources.
- The reef crest, slope, and offshore reefs are generally under-protected in Kiribati. It is important to consider extending the protection boundary of KBAs and no-take zones to past the extent of the reef slope.
- Collaboration with the community on fisheries site protection developed in partnership with the Department of Fisheries provides opportunities to build on successful management efforts.
- Since some KBAs are under community tenure, conservation of these sites depends on close and effective collaboration between the community, government, donors, NGOs, and community groups.
- KBAs should be promoted through all types of media, further enhancing the awareness aspect of biodiversity conservation.
- The involvement of local community and institutions to participate in conservation of KBA is key to the success of protecting biodiversity.

Recommendations for MELAD to achieve national conservation targets based on the KBA conservation targets

- Develop an overall strategy for the expansion and improved management of the PA system, including the addition of KBAs identified here, starting with the highest priority sites.
- Support and revive traditional knowledge and management measures for conservation and resource management.
- The Environment Act 1999 provides an option to empower communities in the management of their traditional resources. Assist communities to clarify coastal marine ownership and use of resources in regards to traditional owners and management. Investigate the potential for co-management with island councils of resources as an option for the protection of areas and species.
- Identify alternative livelihoods and economic incentives for loss of local fishing revenue of protected areas. Investigate tax incentives for good fisheries management.
- Work with local communities and other stakeholders to complete management plans for all protected areas and then secure the resources necessary for implementation.
- Establish a regular assessment mechanism to track the effectiveness of management of PAs and KBAs using tools such as the World Bank's Management Effectiveness Tracking Tool (METT), or World Wildlife Fund's (WWF's) Rapid Assessment and Prioritization of Protected Areas Management (RAPPAM) tool.
- Implement interventions based on the results of the management effectiveness assessments.
- Implement protocols for data collection and management for ecological survey data. It will be much easier to revise the KBAs

and other conservation targets in future if ecological data are collected, managed and archived according to agreed protocols.

- Prioritise amongst the KBAs using additional socio-economic data, such as community commitment and economic feasibility.
- Prioritise future ecological research based on the findings of the gap analysis.
- Revise the KBA gap analysis every few years as new data become available.
- Start working on the "low-hanging fruit:" establish protected areas in high priority KBAs that can be established at the lowest cost and on uninhabited islands where protection status is already implemented and strengthening and updating (or creating) current management plans of these areas. Establish protected areas on inhabited islands where community commitment is already available, and can be integrated into current projects.

Conclusion

Funding and human resources and time for conservation are limited. All KBAs in Kiribati have special value to the people and biodiversity of Kiribati, and it is vital that all efforts are as efficient as possible and have buy-in from all relevant sectors of society, especially the island communities with traditional tenure over the KBAs. By fully involving all stakeholders and related economic sectors including fisheries, agriculture, finance and planning, Kiribati will be able to identify the most appropriate way to sustainably conserve our natural heritage, providing for our current and future needs.

Effective and efficient management of KBAs for their conservation values is not only important for the ecological integrity of Kiribati, but also for the cultural, spiritual and economic vitality of the country. We encourage all partners and stakeholders to work together to conserve Kiribati's KBAs and natural capital while we still can.

Fisherman in Tarawa lagoon, Gilbert Islands group
Photo by Tony Whincup

Octopus catch - Overfishing of certain fish species in coastal areas can indirectly lead to the increase in numbers of other species such as Octopus. However, increases of such species can unbalance the ecosystem and can negatively effect community livelihoods over time.
Photo by Tony Whincup

Six Key Recommendations

1. Action should and can be taken now to protect native biodiversity, as we know key sites for conservation and many of the species at risk of extinction.
2. Conservation of KBAs depends on close and effective collaboration between government, island councils, donors, non-governmental organizations (NGOs), church groups, and community groups and individuals.
3. KBAs that include uninhabited islands and already have protection status should have management plans updated and reviewed. On inhabited islands that are KBAs, priorities should be targeted to work with communities who are enthusiastic to safeguard biodiversity and establish protected areas.
4. Existing environmental laws and fisheries regulations need to be promoted, followed and enforced.
5. Awareness must be raised at all levels of society about the threatened and ecologically important species in Kiribati, the sites where they are found, and what must be done to conserve them.
6. Future ecological research should focus on increasing our understanding of the biology of native species and how to conserve them, including establishing sustainable levels of harvest for harvested species.

Appendix A: Additional maps and graphs used in KBA analysis.

Map A: Gilbert Islands with number of individual IUCN Red Listed species

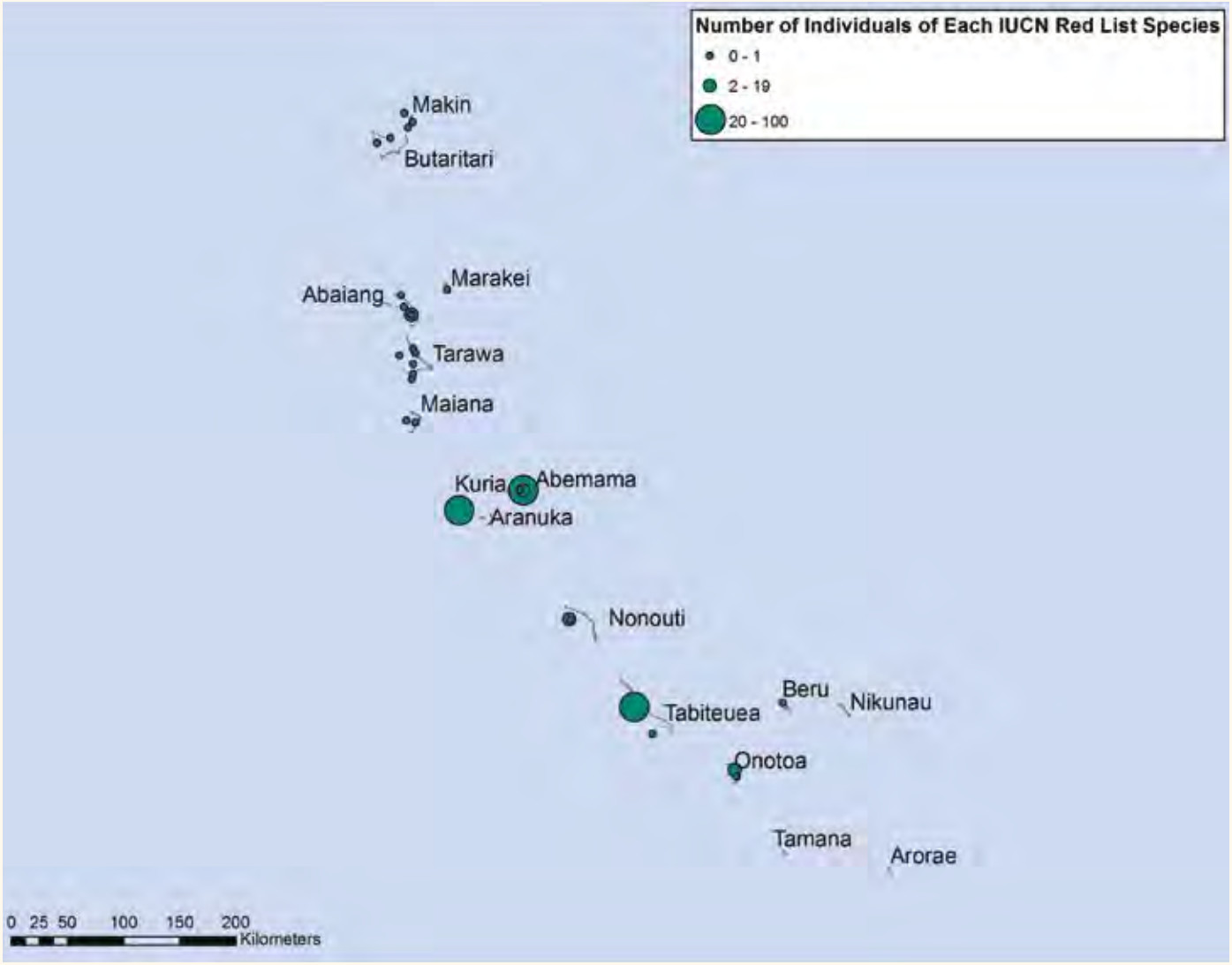


Table A: Threatened species of Kiribati (2010 IUCN Red List) used in KBA analysis.

NUMBER	GENUS	SPECIES	KIRIBATI NAME	COMMON NAMES	STATUS	TREND
1	Eretmochelys	imbricata	Tabakea, te borauea	Hawksbill turtle	CR	Decreasing
2	Cheilinus	undulatus	Karon	Giant Wrasse, Humphead, Humphead Wrasse, Maori Wrasse, Napoleon Wrasse, Truck Wrasse, Undulate Wrasse	EN	Decreasing
3	Chelonia	mydas	On	Green Turtle	EN	Decreasing
4	Acrocephalus	aequinoctialis	Te Bokikoko	Kiritimati Reed-warbler, Bokikokiko	EN	Decreasing
5	Montipora	dilatata		Hawaiian Reef Coral	EN	Decreasing
6	Prosobonia	cancellata		Tuamotu Sandpiper, Sharp-billed Sandpiper	EN	Decreasing
7	Nesofregetta	fuliginosa	Te Bewebwe ni Marawa	White-throated Storm-petrel	EN	Decreasing
8	Pterodroma	alba	Te ruru	Phoenix petrel	EN	Decreasing
9	Vini	kuhlii	Te Kura	Kuhl's (Scarlet-breasted) Lorikeet	EN	Decreasing
10	Alopias	vulpinus		Common Thresher Shark	VU	Decreasing
11	Bolbometopon	muricatum		Bumphead Parrotfish, Double-headed Parrotfish, Green Humphead Parrotfish, Humphead Parrotfish	VU	Decreasing
12	Epinephelus	lanceolatus		Brindle Bass, Brindled Grouper, Giant Grouper, Queensland Groper	VU	Decreasing
13	Isurus	oxyrinchus		Shortfin Mako	VU	Decreasing
14	Numenius	tahitiensis		Bristle-thighed Curlew	VU	Decreasing
15	Physeter	macrocephalus		Sperm Whale, Cachelot, Pot Whale, Spermacet Whale	VU	Unknown
16	Plectropomus	laevis		Blacksaddled Coral Grouper	VU	Decreasing
17	Plectropomus	areolatus		Polkadot Cod, Spotted Coral Trout, Squaretail Coralgrouper, Square-tail Coral Trout, Squaretail Coral Trout, Squaretail Grouper, Squaretail Leopardgrouper	VU	Decreasing
18	Pterodroma	cookii		Cook's Petrel	VU	Increasing
19	Pterodroma	cervicalis		White-necked Petrel	VU	Increasing
20	Pterodroma	pycrofti		Pycroft's Petrel	VU	Increasing
21	Rhincodon	typus		Whale Shark	VU	Decreasing
22	Stegostoma	fasciatum	Kimoa	Leopard Shark, Zebra Shark	VU	Decreasing
23	Thunnus	obesus	Kaukanoanimata	Bigeye, Bigeye Tuna, Big Eye Tuna, Coffrey, Tuna	VU	Decreasing
24	Tridacna	gigas	Aubunga/ Te Kima	Giant Clam	VU	Decreasing
			Coral species			

NUMBER	GENUS	SPECIES	KIRIBATI NAME	COMMON NAMES	STATUS	TREND
25	Acanthastrea	bowerbanki		Starry cup Coral	VU	Unknown
26	Acanthastrea	ishigakiensis		Starry cup Coral	VU	Unknown
27	Acropora	abrolhosensis		Staghorn Coral	VU	Decreasing
28	Acropora	aculeus		Staghorn Coral	VU	Decreasing
29	Acropora	acuminata		Staghorn Coral	VU	Decreasing
30	Acropora	anthocercis		Staghorn Coral	VU	Decreasing
31	Acropora	aspera		Staghorn Coral	VU	Decreasing
32	Acropora	dendrum		Staghorn Coral	VU	Decreasing
33	Acropora	donei		Staghorn Coral	VU	Decreasing
34	Acropora	echinata		Staghorn Coral	VU	Decreasing
35	Acropora	globiceps		Staghorn Coral	VU	Decreasing
36	Acropora	horrida		Staghorn Coral	VU	Decreasing
37	Acropora	kirstyae		Staghorn Coral	VU	Decreasing
38	Acropora	listeri		Staghorn Coral	VU	Decreasing
39	Acropora	lovelli		Staghorn Coral	VU	Decreasing
40	Acropora	microclados		Staghorn Coral	VU	Decreasing
41	Acropora	palmerae		Staghorn Coral	VU	Decreasing
42	Acropora	paniculata		Staghorn Coral	VU	Decreasing
43	Acropora	polystoma		Staghorn Coral	VU	Decreasing
44	Acropora	retusa		Staghorn Coral	VU	Decreasing
45	Acropora	solitaryensis		Staghorn Coral	VU	Decreasing
46	Acropora	speciosa		Staghorn Coral	VU	Decreasing
47	Acropora	spicifera		Staghorn Coral	VU	Decreasing
48	Acropora	striata		Staghorn Coral	VU	Decreasing
49	Acropora	vaughani		Staghorn Coral	VU	Decreasing
50	Acropora	verweyi		Staghorn Coral	VU	Decreasing
51	Alveopora	allingi		Alveopora coral	VU	Unknown
52	Alveopora	fenestrata		Alveopora coral	VU	Unknown
53	Alveopora	marionensis		Alveopora coral	VU	Unknown
54	Alveopora	verrilliana		Alveopora coral	VU	Unknown
55	Anacropora	puertogalerae			VU	Decreasing
56	Astreopora	cucullata			VU	Decreasing

NUMBER	GENUS	SPECIES	KIRIBATI NAME	COMMON NAMES	STATUS	TREND
57	Barabattoia	laddi			VU	Decreasing
58	Caulastrea	curvata			VU	Decreasing
59	Cyphastrea	ocellina			VU	Decreasing
60	Cyphastrea	agassizi		Agassiz's Coral	VU	Decreasing
61	Euphyllia	cristata			VU	Stable
62	Galaxea	astreata			VU	Decreasing
63	Heliopora	coerulea		Blue Coral	VU	Decreasing
64	Isopora	cuneata			VU	Decreasing
65	Leptoria	irregularis			VU	Unknown
66	Leptoseris	incrustans			VU	Decreasing
67	Leptoseris	yabei			VU	Decreasing
68	Lobophyllia	diminuta			VU	Unknown
69	Montastrea	multipunctata			VU	Unknown.
70	Montipora	altasepta			VU	Unknown
71	Montipora	angulata			VU	Decreasing
72	Montipora	australiensis			VU	Decreasing
73	Montipora	calcarea			VU	Decreasing
74	Montipora	caliculata			VU	Decreasing
75	Montipora	capricornis			VU	Decreasing
76	Montipora	cebuensis			VU	Decreasing
77	Montipora	corbettensis			VU	Decreasing
78	Montipora	crassituberculata			VU	Decreasing
79	Montipora	lobulata			VU	Decreasing
80	Montipora	samarensis			VU	Decreasing
81	Montipora	flabellata		Encrusting Coral	VU	Decreasing
82	Montipora	patula		Spreading/ sandpaper rice Coral, Mound/Ridge Coral	VU	Decreasing
83	Pachyseris	rugosa			VU	Decreasing
84	Pavona	bipartita		Pavona Coral	VU	Decreasing
85	Pavona	cactus		Cactus Coral	VU	Unknown
86	Pavona	decussata		Pavona Coral	VU	Unknown
87	Pavona	venosa		Pavona Coral	VU	Unknown.

88	Pectinia	alcicornis			VU	Unknown
89	Pectinia	lactuca		Lettuce Coral	VU	Unknown
90	Physogyra	lichtensteini			VU	Unknown.
91	Pocillopora	elegans			VU	Unknown
92	Porites	attenuata		Porites Coral	VU	Unknown
93	Porites	horizontalata		Porites Coral	VU	Unknown.
94	Porites	nigrescens		Porites Coral	VU	Unknown
95	Psammocora	stellata		Starry Petaloid Coral	VU	Unknown.
96	Turbinaria	mesenterina		Turbinaria Coral	VU	Unknown
97	Turbinaria	patula		Turbinaria Coral	VU	Unknown.
98	Turbinaria	peltata		Bowl Coral	VU	Unknown
99	Turbinaria	reniformis		Yellow scroll Coral	VU	Unknown
100	Turbinaria	stellulata		Turbinaria Coral	VU	Unknown.

Note: IUCN Red List Status Abbreviations: (CR) Critically Endangered; (EN) Endangered; (VU) Vulnerable. Coral species in bold are globally threatened species that have been identified by J. Maragos in the Line Islands but have yet to be listed on the IUCN Red List for Kiribati.

Table B: Species and areas of local concern.

SPECIES (COMMON AND KIRIBATI NAME)	ISLAND	SPECIES (COMMON AND KIRIBATI NAME)	ISLAND
Pandanus - tall straight	Abaiang	Tridacna sp.	Makin
Soulamara amara	Abaiang	Anadara strombus	Makin
sea grass	Abaiang	Te Nikababuti	Makin
rare mangrove	Abaiang	Tridacna sp	Marakei
Temwakemwake	Abaiang	Anadara strombus	Marakei
Tearantenneia	Abaiang	Te kiaou	Marakei
TEKAIMAIU	Abaiang	Hawksbill turtle	Nonouti
Bwabwai	Abaiang	Green turtle	Nonouti
Seagrass bed	Abemama	lobster	Nonouti
White mangrove	Abemama	bonefish	Nonouti
Seagrass tall new	Abemama	bivalves	Nonouti
Turtle nesting beach	Abemama	Tridacna sp	Onotoa
Marshland	Abemama	Anadara strombus	Onotoa
Arrowroot	Abemama	Tetiare	Tamana
Pandanus	Abemama	Green turtle	Tarawa
kiboia- fishing pole tree	Abemama	Hawksbill turtle	Tarawa
Pandanus	Abemama	Bonefish	Tarawa
garfish	Aranuka	T. squamosa	Tarawa
Te Tongo	Aranuka	T. maxima	Tarawa
sharks	Arorae	skip jack	Tarawa
anadara strombus	Beru	Bivalves	Tarawa
Tridanca sp	Beru	Te Aitoa	Tarawa
Green and hawksbill turtle	Butaritari	Te Aroua	Tarawa
Te Aitoa	Butaritari	Te Nikababuti	Tarawa
Te Nikababuti	Butaritari	Te Ngea	Tarawa
Te Ngea	Butaritari	Te Tongo Buangi	Tarawa
Te Tongo	Butaritari	Te Tongo	Tarawa
Te Tongo Buangi	Butaritari	Teniingaun	Tarawa
Teniingaun	Butaritari	Tetiare	Tarawa
Temwakemwake	Butaritari	Tekiaiai	Tarawa
Bwabwai (Ikaraoi/katutu) (giant swamp taro)	Butaritari	Te kiaou	Tarawa
garfish	Kuria	Te kaura	Tarawa
bonefish	Maiana	Te kaura	Tarawa

Figure A: Gilbert Islands Geomorphic Score

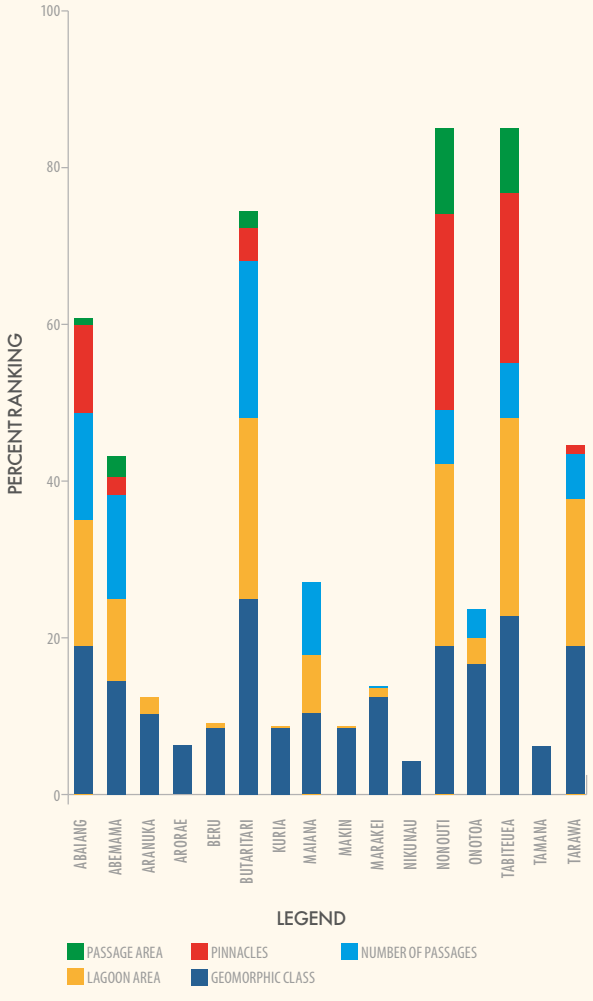


Figure B: Phoenix Islands Geomorphic Score

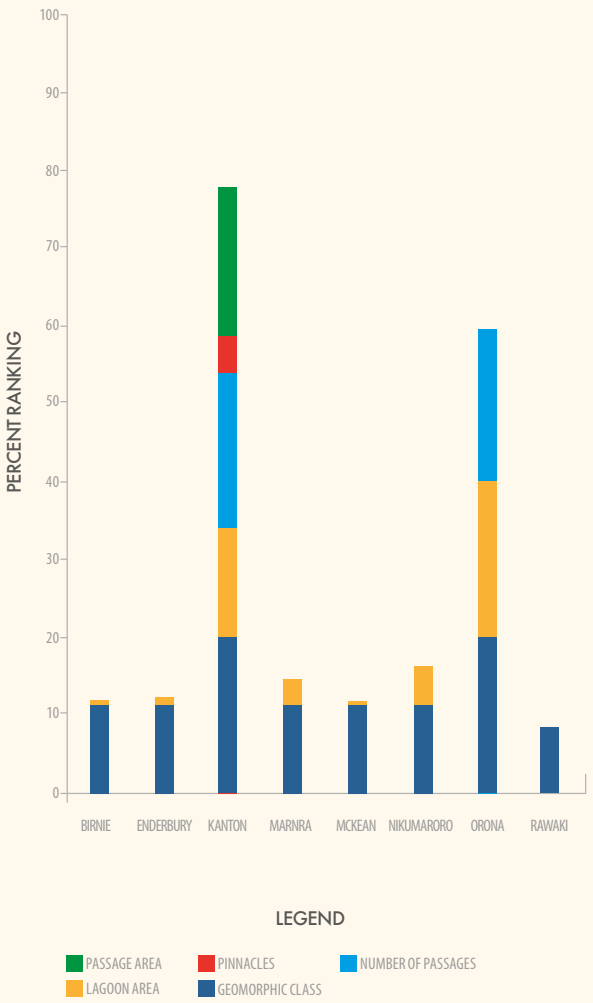
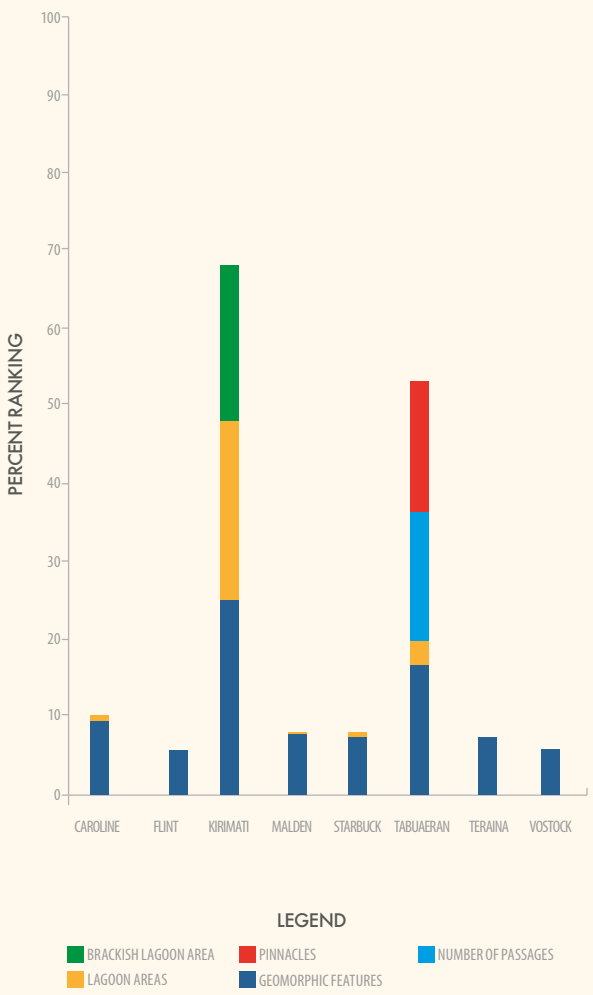


Figure C: Line Islands Geomorphic Score



The Geomorphic score shown in these graphs depicts the comparative habitat complexity amongst the islands. The calculated score is the weighted sum of the 5 habitat characteristics listed in the key for each archipelago; Passage area, Number of passages, Pinnacles, Lagoon Area, Geomorphic Class. For each characteristic the maximum value for that characteristic for the archipelago was assigned a value of 1 with all other atolls scoring some percentage of one - (highest value per atoll for the archipelago divided by the specific atoll's value). Each of the 5 attributes were equally weighted and added to the final score; each of the 5 classes is worth 20% of the final score. If an atoll was to have the largest lagoon, most geomorphic classes, highest number of passages and pinnacles and most passage area it would score 100%.

Table C: Island Geomorphic profile.

NAME:	ISLAND TYPE	NO. OF ISLES*	ISLAND AREA (KM)	LATITUDE	REEF TYPE	REEF PERIMETER (KM)	LAGOON AREA (KM)	NUMBER OF PASSES/ CHANNELS
Banaba								
Banaba	Raised limestone	1	8.5	-	Fringing (table)	11	0	0
Gilbert Islands								
Makin	Low coral	7	6.7	3.38	Atoll	29	0.4	0
Butaritari	Low coral	23	13.6	3.15	Atoll	110	242	8
Marakei	Low coral	2	13.5	2.00	Atoll	26	16	0
Abaiang	Low coral	31	16.0	1.83	Atoll	102	245	10
Tarawa	Low coral	64	31.9	1.43	Atoll	107	332	1
Maiana	Low coral	17	15.9	0.92	Atoll	58	77	1
Abemama	Low coral	6	27.8	0.40	Atoll	66	151	2
Kuria	Low coral	2	12.3	0.22	Fringing (table)	27.5	1	0
Aranuka	Low coral	14	15.5	0.15	Atoll	36	20	1
Nonouti	Low coral	24	29.2	-0.67	Atoll	101	355	11
Tabiteuea	Low coral	63	38.0	-1.33	Atoll	191	319	2
Beru	Low coral	1	14.7	-1.33	Atoll	36	7	0
Nikunau	Low coral	1	18.2	-1.35	Fringing (table)	31	0	0
Onotoa	Low coral	12	13.5	-1.87	Atoll	52.5	58	7
Tamana	Low coral	1	4.8	-2.50	Fringing (table)	12.5	0	0
Arorae	Low coral	1	9.5	-3.38	Fringing (table)	20	0	0
Phoenix Islands								
Rawaki (Phoenix Island)	Low coral	1	.7	-3.72	Atoll	6	0	0
Orona Atoll (Hull Island	Low coral	12	7.8	-4.50	Atoll	27	26	0
Abariranga (Kanton) Island	Low coral	1	11.8	-2.82	Atoll	39	43	1
Nikumaroro (Gardner Island)	Low coral	1	4.3	-4.68	Atoll	18.8	4.7	0
Enderbury Island	Low coral	1	5.8	-3.13	Atoll	14.5	0.6	0

Manra	Low coral	1	2.6	-4.46	Atoll	13.7	3	0
McKean Island	Low coral	1	0.4	-3.60	Fringing (table)	4.9	0.1	0
Birnie	Low coral	1	0.52	-3.60	Fringing (table)	7.1	0.02	0
Line Islands								
Caroline (Millennium)	Low coral	38	7.1	-9.96	Atoll	29.5	5.3	0
Flint	Low coral	1	0.1	-11.43	Fringing (table)	12.4	0	0
Kiritimati	Low coral	874	399	1.89	Atoll	146	131	0
Malden	Low coral	1	25.5	-4.01	Atoll	29.7	11.8	0
Starbuck	Low coral	1	24.9	-5.64	Atoll	28.3	0.9	0
Tabuaeran (Fanning)	Low coral	4	62	3.91	Atoll	52.7	77	1
Teraina (Washington)	Low coral	1	11.9	4.69	Fringing (table)	27.5	2.7	0
Vostok	Low coral	1	0.26	-10.06	Fringing (table)	4.3	0	0

Lagoon area calculations derived from lagoon, brackish lagoon and inner slope features. Number of passages derived from passage and channel feature and in the case of the Gilbert Islands adapted from Maragos et al. 1996. Calculations based on Andréfouët 2005.

Map B: Line Islands current Protected Area management.

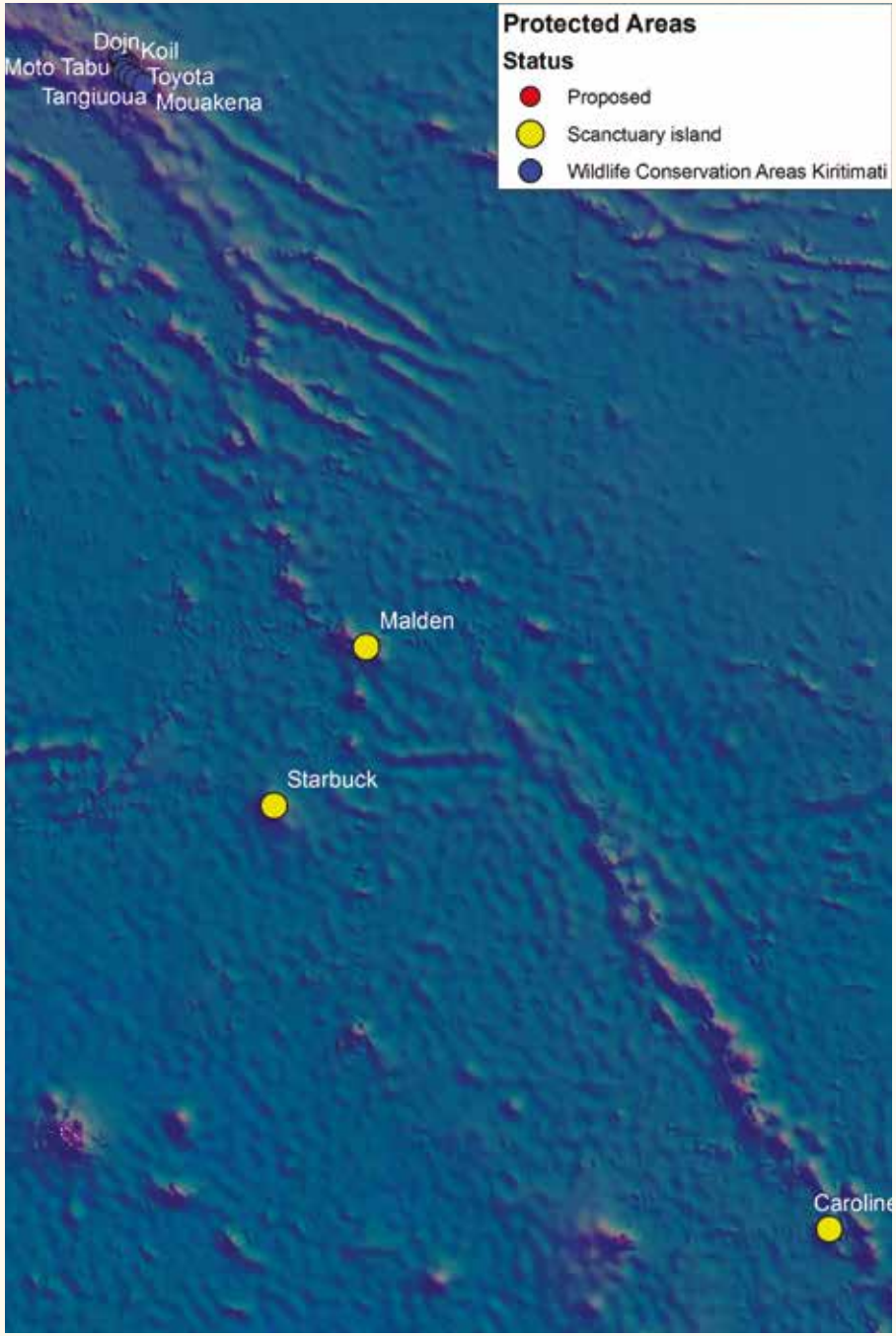


Table D: IUCN Protection Categories:

CATEGORY	STATUS
Ia	Strict Nature Reserve
Ib	Wilderness Area
II	National Park
III	Natural Monument or Feature
IV	Habitat/Species Management Area
V	Protected Landscape/Seascape
VI	Protected Area with sustainable use of natural resources

Please refer http://en.wikipedia.org/wiki/IUCN_Protected_Area_Management_Categories for detailed explanation of each category.

Appendix B: Areas of Local Biocultural Concern

Introduction

The following is a brief list of known areas of local concern for what has come to be called biocultural diversity. Biocultural diversity includes not only the diversity of living species, habitats and ecosystems but also the broad spectrum of human engagement with the physical environment, including conceptual, technological, and social systems. It "comprises the diversity of life in all of its manifestations – biological, cultural, and linguistic – which are interrelated (and likely co-evolved) within a complex socio-ecological adaptive system" (Maffi and Woodley, 2010: 5). From this perspective species of concern are socially significant organisms, including their cultural meaning and use. These may include food species or those of technical and ritual significance.

A result of this approach is the realization that local interest in 'biodiversity' is often different than global concerns. However, this does not preclude synergies between the conservation of locally important and globally endangered species and may, in fact, provide important opportunities. Attention to local concerns over species and habitat loss can, by meeting local needs, facilitate community engagement in broader conservation efforts. Furthermore, local concerns provide a different perspective on local species and habitat impacts as well as possible causes.

Several insights emerge from the brief biocultural maps given below. Among these are the adverse impacts of causeways, land reclamation, sand mining and other development projects. Causeway development has emerged as especially detrimental to local food species and habitats. Inundation of agricultural land and freshwater resources by seawater is also a recurring theme and is strongly linked to climate change. Other locations are of ritual or religious significance and may not be currently under threat.

Finally, with the exception of Abemama, all biocultural information given below has been provided by Natan Itonga, Cultural Officer for the Republic of Kiribati. His expertise in the cultural diversity of Kiribati and his generosity has been of great value to this KBA gap analysis.

Gilbert Islands

Makin

Causeway construction led to the extinction of many lagoonal species, including shellfish (Te Bun, Te Koikoi, Te Nikatona/ Nikabibi, and Te Were), tuna, sharks, and other ocean fish.

There is a rare species of mangrove found around Makin lagoon called Nikababuti that is found only in Makin and Butaritari (and one individual on Abemama). It is used to make garlands and ornaments that are worn at festivals. Unfortunately, since the causeway was built this species is becoming less common.

On Keibu islet, sea water is inundating a babai (taro) swamp and killing the babai.

There is a site on Onne Islet called Te Tongo Buangi that is the location of a shrine within the mangroves where fisherman can go to ask for luck in fishing. Furthermore, this species of mangrove is only found in this location on Makin. It is used in traditional medicine.

Butaritari

At Kuma the people used to be known for their ability to magically call dolphins close to shore. However, this skill has been lost since the disappearance of the dolphins.

At Ukiangang (South West corner of the atoll) there is a very good fishing spot called Kabwate (a translation of the English word 'cupboard') because of its plentiful tuna and other important food fish.

On Bikati islet te were is the main subsistence and cash resource. Much of it is exported to Tarawa.

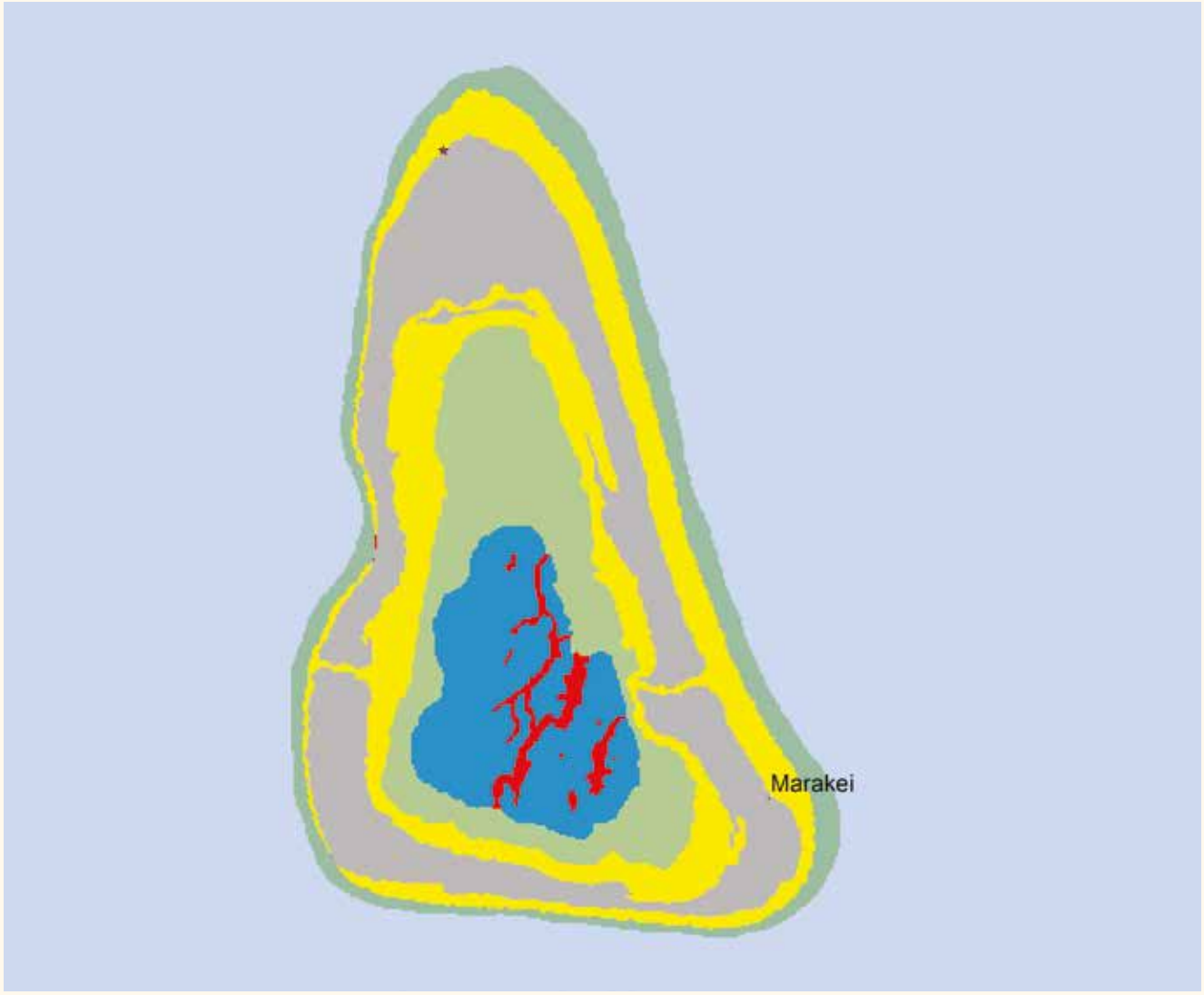
Makin and Butaritari

Marakei

Near Raweai Village there is a fishing site famous for its abundance of te Anaa. While this fish can be found on other islands, it has always been most plentiful on Marakei. The runs of te Anaa are said to have been on the order of millions of fish, which the villagers would scoop up easily with nets. However, the fish runs are no longer as frequent or as plentiful.

Marakei is also known for its abundance of flying fish.

Marakei



Abaiang & Tarawa

Abaiang

At Tabontebike village, seawater has inundated a babai swamp that used to be the main source of taro for the village. In 2006 all the babai was killed. Inundation of this historic taro swamp is believed to be an effect of climate change.

The village of Tebunginako has been moved because of coastal erosion.

Te Were are gathered near Nuotoea and Ribona villages and either eaten or exported to Tarawa. However, the size, and perhaps the population of this species, has decreased.

Tarawa

On the northern tip of Tarawa there is a good fishing site for te Maebo, a fish species that can be caught monthly at this location with scoop nets. Family owned fish traps are also used at this site for collective fishing. Villagers have noticed a decrease in the size of te Maebo caught.

A rich site for te bun gathering used to exist just south of the te Maebo site. However, this species has become extinct in this location within the last ten years. The cause is attributed to causeway construction in South Tarawa and sea cucumber fishing (in which dumping of sea cucumber innards into the lagoon is believed to be toxic, as sea cucumber guts contain a holothurian toxin which can kill fish and other shell fish).

Bikerman Islet used to be a popular picnic destination that contained pandanus, coconut and many bird species. However, since the building of the causeway in South Tarawa it has been eroded into a mere sandbank.

Nuatabu village is an important site for te katura (a shellfish). However, since the building of the causeway its habitat has been affected by erosion. The population of te katura is decreasing as a result.

The bonefish population in Tarawa lagoon is perceived to be decreasing because of overharvesting.

Dolphins used to enter the lagoon and leave through a passage where the milkfish ponds are currently located (near the airport). However, the passage has been reclaimed. Dolphins are now very rare in the lagoon and no longer occur in this site at all.

Eita village is known for its te bun and te nouo (shellfish). However, since much of the lagoon near this site has been modified by structures such as dykes, seawalls, and land reclamation, both the size and population of these species has decreased.

Maiana, Kuria & Aranuka

Maiana is known throughout Kiribati for bonefish.

Kuria has two royal milkfish ponds that were property of the king and are still claimed by his descendents. Currently the ponds are dry and the cause is attributed to changing weather patterns.

Maungan te Tongo is a bird sanctuary that was established by the island council. It is full of mangrove habitat and contains a shrine of local importance.

Kuria

Abemama

Site 1: A variety of pandanus that is rare on the island because its leaves have no spines. It is especially good for weaving and does not produce fruit. It grows to about four to five meters high.

Site 2: The only white mangrove tree on the island, measuring four meters tall and about 25 centimetres in diameter. It was previously thought that this species only occurs on Butaritari and Makin; it may be the only extant individual outside these two northern islands.

Site 3: A large bed of seagrass (common type) on the ocean side of the island, near the construction site for a new causeway.

Site 4: Kaiboia ("fishing pole tree"), which is used for making fishing poles. This species is only found in a few locations on the island and is not currently being managed.

Site 5: Another site for the spineless pandanus found at site 1.

Site 6: Historic WWII Japanese bunker.

Site 7: A site for gathering arrowroot (makemake), which is commonly used for making head dresses (te bau) and dancing skirts.

Site 8: A potentially invasive algae that is covering much of the foreshore. It is perceived to be having a negative effect on the bivalves. Alternatively, it may be the case that over harvesting of bivalves has caused the outbreak.

Site 9: An unusual variety of seagrass that is ½ meter long or more that occurs in a large patch. The site is known for good fishing.

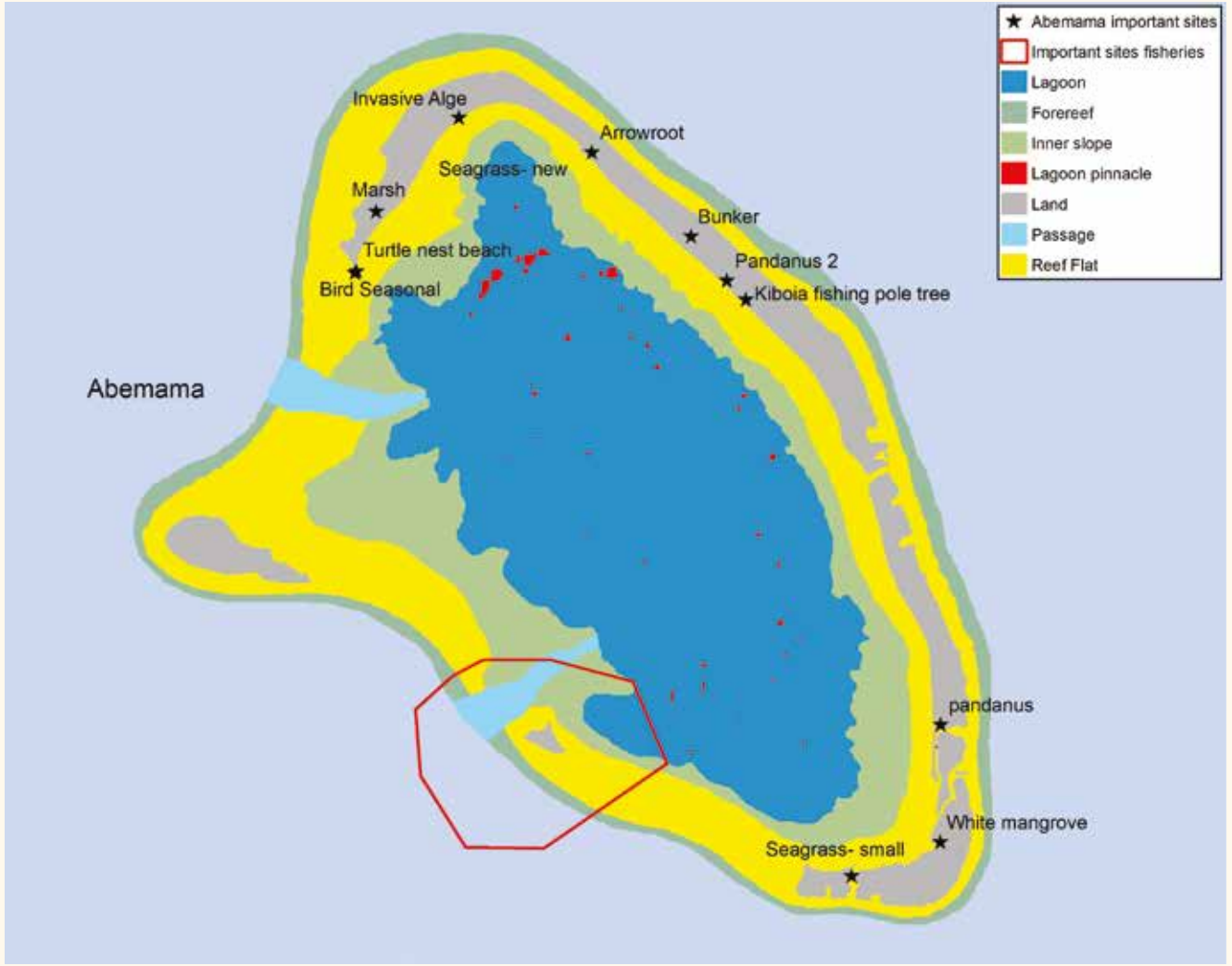
Site 10: A large wetland area with sedges measuring about 800 meters across. It was formerly used for milkfish. Currently, the sludge from the marsh is used for road maintenance.

Site 11: A turtle nesting site that is popular for turtle harvesting. It is common practice to harvest turtles before they lay eggs.

Site 12: A seasonal bird nesting site; however, what season and which birds was unclear.

Site 13: A special fisheries site off Bike Islet where juvenile Chenlenus undulates have been seen inside the reef. The ocean side is also known as a good tuna and shark fishery.

Abemama



Nonouti

The people of Nonouti are known for their skill in fishing for eels (te rabono) in the lagoon. As a result, eels are more important to villagers than on other islands. The lagoon also has a relative abundance of bonefish.

There is a bird sanctuary on Noumatong Iset that is being affected by erosion. The trees on the island, important bird habitat, are being affected. This location may also be important for the local economy since the bird sanctuary is a tourist site.

Nonouti

Tabetuea

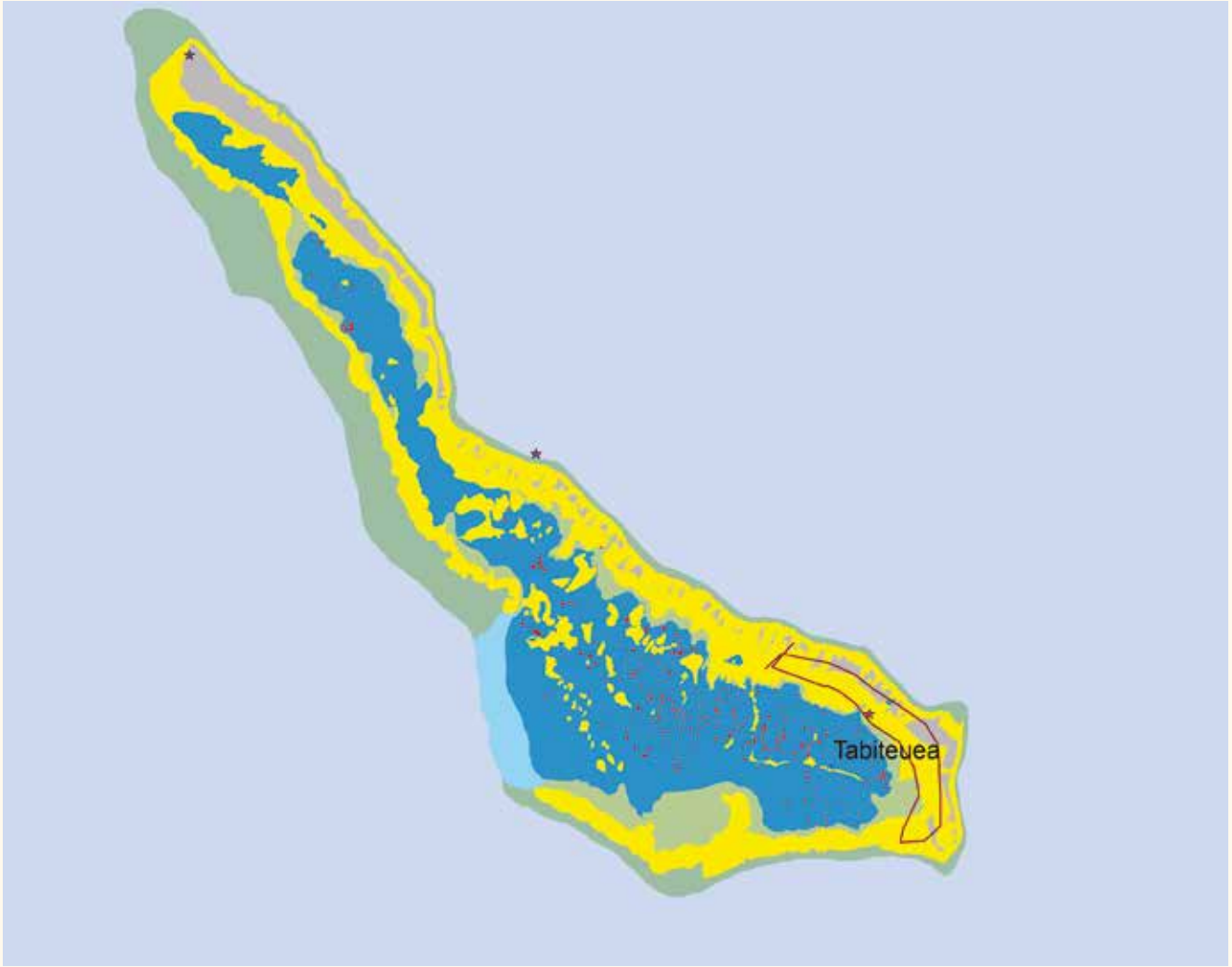
Warrior 'stone men' stand along the beach on Tabetuea. These large stone constructions were intended to intimidate invading armies. This site is now in the process of becoming an endangered cultural heritage area.

On North Tabetua, at Te Nei Nikairo, there are family-owned fish ponds and fish traps. Both of these structures are still in use and are important for community life. They are important examples of local resource management in which each family controls a share of the village resources, and may be worth further investigation.

Te ibo, sea worm, is collected in the near shore area on the lagoon side and is both used locally and exported to Tarawa.

Like Nonouti, the villages of Tabetuea are known for their skill in eel fishing, making this resource even more important relative to most other islands.

Tabetuea



Beru & Nikunau

Beru

After construction of the causeway blocked off the lagoon, the island council declared the lagoon a protected area for fishing, which means that fishing is only allowed with a permit. This has forced Autukia village, which is located next to the lagoon, to either fish on the ocean side of the atoll or walk to the other side of the island. While the ocean side is relatively close to the village, strong winds are common and make fishing difficult.

Not far from Autukia village is a place where all villages can gather salt.

Another island council-owned fish pond protected area at another location has been under management longer and contains larger fish.

Although the lagoon does not contain te bun, other small shellfish, such as te nikatona/te nikabibi, te kourama/ te koumwara, te koumwaai, are gathered for food.

On the southern tip of Beru in the enclosed lagoon there is a rare edible algae called bokaboka locally that can be gathered. This is the only site where it is found in Kiribati. It is used in family, village, and island ceremonies.

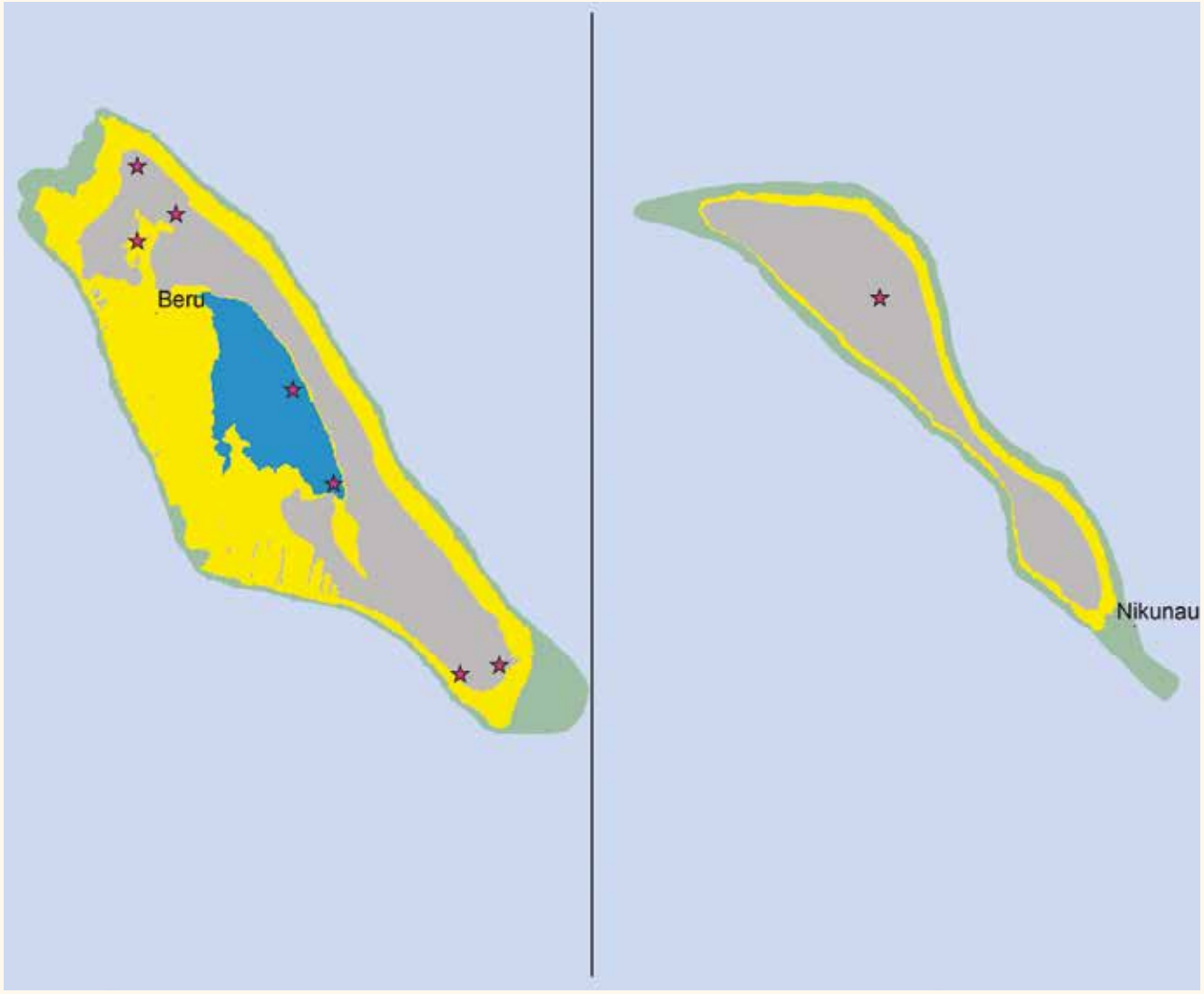
There is a location where long extinct seashells can be found in a freshwater area, indicating that it used to contain saltwater.

Finally, flying fish can be found just outside the lagoon.

Nikunau

Nein Riiki, a milkfish pond found near Rungata village can be used by villagers. It is significantly Nikunau's only source of lagoonal fish since the island does not have a lagoon. Although the milkfish disappeared at one time, it is being restocked with fish from Tarawa.

Beru & Nikunau



Onotoa

Tabuarorae village, on the south end of the island, is affected by coastal erosion attributed to the building of a causeway. Erosion has resulted in islet narrowing and the disappearance of fresh water. Consequently, villagers must travel 600 m to the nearest source of drinkable water.

Onotoa

Tamana & Arorae

Tamana

This island has banned the use of motorized boats for anything but the transportation of cargo to protect nearshore fisheries and to prevent unequal access to resources that would result from unequal access to motorized boats. Tamana is known for its cultural emphasis on self-reliance and reliance on personal skill.

Arore

Arore is geophysically similar to Tamana. However, perhaps because it has not banned motor boats, fishers on this island seem to obtain fewer fish from near shore areas. Instead, villagers travel farther from the island to catch sharks and other oceanic species. The sharks are exported to China via Tarawa.

Tamana & Arorae

Line Islands

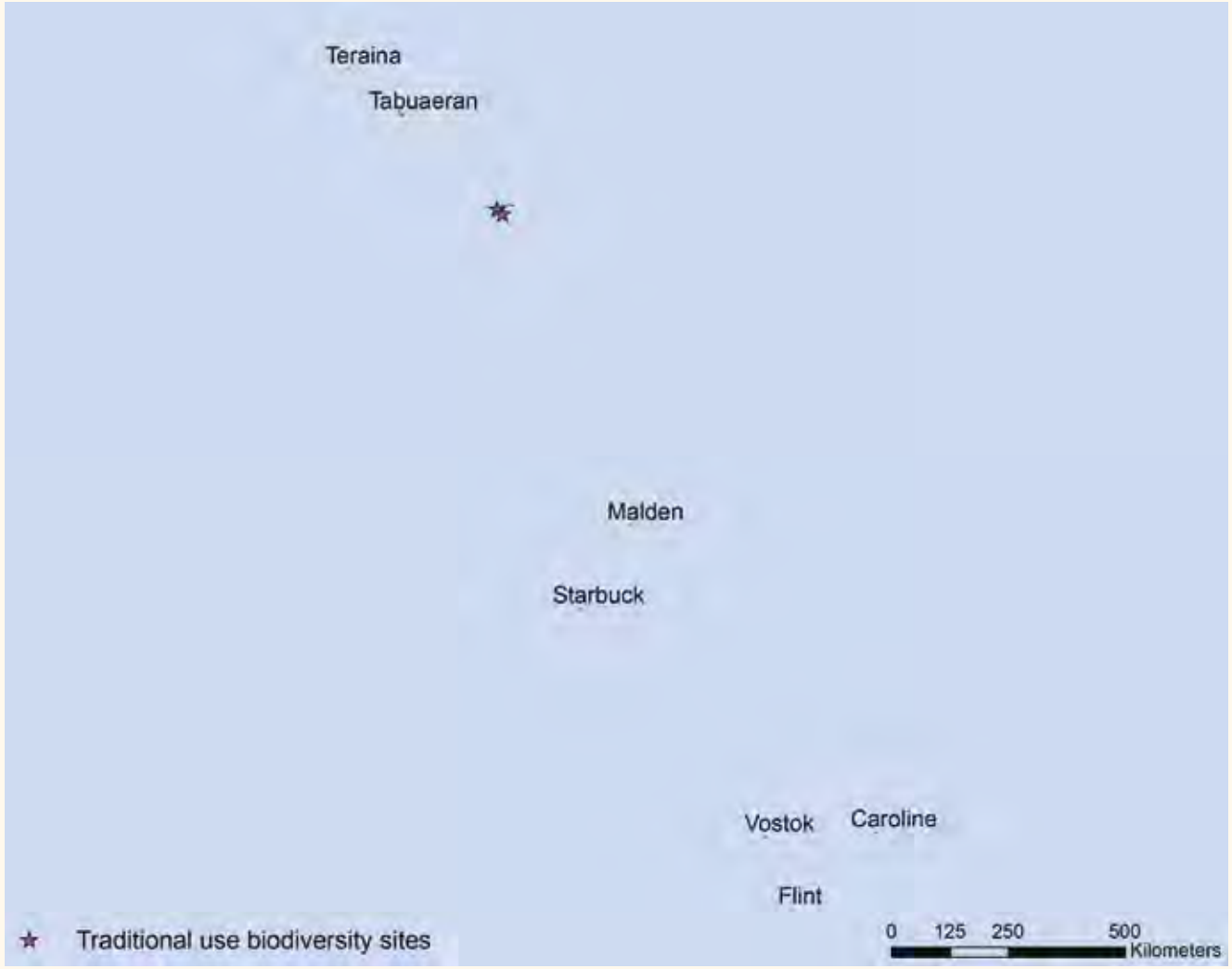
Kirimati

Since the 1970s both the size and quality of milkfish has declined. During the same period the number of frigate birds has also declined significantly due to egg harvesting and consumption of the birds. Although several bird sanctuaries exist, a hotel has been constructed in important bird habitat within the te taraariki bird sanctuary. Finally, because of population pressures and construction, the number of coconut trees has significantly declined as indicated by the decline of copra production near more heavily settled areas.

Teraina

Once an important holding of the Burns Philp Copra Company, Teraina is a relatively tall island covered in dense coconut. A deep freshwater pond is located at the top and contains species of freshwater fish.

Line Islands



References

Akoako, N. 2004, Kiribati State of the Environment report 2000 – 2004. Environment and conservation division, Ministry of Environment, Lands and Agriculture Development, Tarawa.

Allen, G., and S. Bailey. 2011. Reef Fishes of the Phoenix Islands, Central Pacific Ocean. Atoll Research Bulletin 589: 83-118.

Andréfouët, S., F. E. Muller-Karger, J. A. Robinson, C. J. Kranenburg, D. Torres-Pulliza, S. A. Spraggins, and B. Murch. 2005. Global assessment of modern coral reef extent and diversity for regional science and management applications: a view from space. Pp 1732-1745 in: Suzuki, Y., T. Nakamori, M. Hidaka, H. Kayanne, B. E. Casareto, K. Nadaoka, H. Yamano, M. Tsuchiya, and K. Yamazato (eds). 10th International Coral Reef Symposium. Japanese Coral Reef Society, Okinawa, Japan. CDROM.

Australian Bureau of Meteorology and CSIRO, 2011. Climate Change in the Pacific: Scientific Assessment and New Research. Volume 1: Regional Overview. Volume 2: Country Reports. http://www.cawcr.gov.au/projects/PCCSP/publications.html downloaded 6/6/2012

BirdLife International 2007. BirdLife's online World Bird Database: the site for bird conservation. Version 2.1. Cambridge, UK: BirdLife International. Available: http://www.birdlife.org

DESD, 1995. North Tarawa Conservation Area, South Pacific Biodiversity Conservation Programme Project Preparatory Document, Division of Environment and Social Development, Bairiki, Tarawa, Republic of Kiribati.

Environment and Conservation Division. 2011. National Integrated Environment Policy 2012-2015. MELAD, Government of Kiribati: Tarawa

Garnett, M. C. 1981. Conservation of seabirds in the South Pacific Region: A review. Pp 547-558 in: Croxall, J. P., P. G. H. Evans, and R. W. Schreiber (eds.). ICBP Technical Publication No. 2: Status and Conservation of the World's Seabirds. International Council for Bird Preservation (ICBP): Cambridge, UK

Gupta, A. 2007. Proposed Important Bird Areas (IBAs) in Kiribati. Unpublished report to Birdlife International.

Kepler, C. B., A. K. Kepler, and D. H. Ellis. 1994. Part II: Seabirds, other terrestrial animals, and conservation. Atoll Research Bulletin 398: 1-61.

Langhammer, P. F., M. I. Bakarr, L. A. Bennun, T. M. Brooks, R. P. Clay, W. Darwall, N. De Silva, G. J. Edgar, G. Eken, L. D. C. Fishpool, G. A. B. d. Fonseca, M. N. Foster, D. H. Knox, P. Matiku, E. A. Radford, A. S. L. Rodrigues, P. Salaman, W. Sechrest, and A. W. Tordoff 2007. Identification and gap analysis of Key Biodiversity Areas: Targets for comprehensive protected area systems. IUCN Best Practice Protected Areas Guidelines Series No. 15, IUCN, Gland, Switzerland.

Maffi, L. and Woodley, E. 2010. Biocultural diversity conservation: A global sourcebook. Earthscan: London.

Maragos J E, Crosby, M.P, McManus J.W. 1996. Coral reefs and biodiversity: A critical and threatened relationship. Oceanography 9(1): 83-99

Margules, C.M. and Sarkar, S. 2007. Systematic conservation planning. Cambridge University Press: Cambridge, UK

MELAD, 2006. National Biodiversity Strategic Action Plan. Ministry of Environment, Lands and Agriculture Development, Tarawa.

MELAD, 2007a National Adaptation Program of Action (NAPA) - Kiribati Climate Change Study Team. Environment and Conservation Division, MELAD, Government of Kiribati: Tarawa. http://www.adaptationlearning.net/sites/default/files/kir01.pdf downloaded 6/6/2012

MELAD, 2007b. Kiribati Country Report to The Conference of Parties (COP) of The Convention on Biological Diversity (CBD). Environment and conservation division, Ministry of Environment, Lands and Agriculture Development, Tarawa.

MFED, 2010. 2010 Census – Preliminary Report produced by the Ministry of Finance and Economic Development, Planning and Statistics with support from SPC

Mittermeier, R.A, N. Myers and C.G. Mittermeier. 1999. Hotspots: Earth's biologically richest and most endangered terrestrial ecoregions. Mexico: CEMEX.

Obura, D. 2011. Coral Reef Structure and Zonation of the Phoenix Islands. Atoll Research Bulletin 589:63-82

Obura D., and G. Stone. 2003. Phoenix Islands. Summary of marine and terrestrial assessments conducted in the Republic of Kiribati, June 5–July 10, 2002. Primal Ocean Project Technical Report NEAq-03-03, New England Aquarium, Boston.

Perry, R. 1980. Wildlife conservation in the Line Islands, Republic of Kiribati. Environmental Conservation 7: 311-318.

Pressey, R. L., I. R. Johnson, and P. D. Wilson. 1994. Shades of irreplaceability - towards a measure of the contribution of sites to a reservation goal. Biodiversity and Conservation 3:242-262.

Pressey, R. L., and K. H. Taffs. 2001. Scheduling conservation action in production landscapes: priority areas in western New South Wales defined by irreplaceability and vulnerability to vegetation loss. Biological Conservation 100:355-376.

Tebano, T. 1999. Country Report for CPBD and CBD: Kiribati. Ministry of Environment and Social Development: Tarawa, Kiribati. http://www.cbd.int/doc/world/ki/ki-nr-01-p1-en.pdf downloaded 6/6/2012

Thaman, R and Tebano, T. 1995. Plants and Fishes of Kiribati. A Preliminary Listing. Curriculum Development Unit, Ministry of Education, Government of Kiribati.

Thomas, F. R. 2002. Kiribati: "Some aspects of human ecology," Forty years later. Atoll Research Bulletin 501: 1-40.

Vane-Wright, R. I., C. J. Humphries, and P. H. Williams. 1991. What to protect - systematics and the agony of choice. Biological Conservation 55:235-254.

A healthy and diverse reef assemblage as found in the Phoenix Islands. Notice the pink crustose coralline algae, which promotes new coral settlement.
Photo © by Randi Rotjan

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